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SERVICE MANUAL
OSCILLOSCOPE
MODEL COS5060

KIKUSUI
ELECTRONICS CORP.

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FRONT PANEL ASSEMBLY 316096

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REAR PLATE ASSEMBLY 316100

CRT ASSEMBLY 316101

CIRCUIT BOARD ASSEMBLY 316103

CIRCUIT BOARD INSTALLATION 316105

COVER & HANDLE ASSEMBLY 316108

1. GENERAL

1.1 Description

Kikusui "5000 Series" Model COS5060 Oscilloscope responds to the customers needs in quality of performance, efficiency, function, design, and cost.

The COS5060 oscilloscope is rugged, highly reliable and a multi-purpose 3-channel 8-trace portable oscilloscope with a 6-inch Domed-mesh type 12 kV post deflection acceleration cathode-ray tube and with fine red internal graticule.

The vertical axis has a maximum sensitivity of 1 mV/DIV, a frequency response of up to 60 MHz -3dB, and a maximum sweep speed of 5 ns/DIV. A waveform magnification function with sweep delay is incorporated for real A, B dual time-base, therefore, this scope has many convenient features and specal functions which make it an ideal instrument for diversified types of research and development of electronic equipment or circuitry. It can also be efficiently used in production line maintenance and service applications. The features of the COS5060 Oscilloscope can be summarized as follows.

1.2 Features

(1) Compactness, light-weight, ruggedness and simple-design:

The diecast frame provides compactness light-weight and ruggedness. The superior structural design is the ultimate in simplicity.

(2) Ease of operation:

Light torque lever switches and pushbutton switches are used. These and other controls are laid out in the most convenient locations making the oscilloscope extremely easy to operate.

(3) High-brightness CRT, high acceleration voltage. (12 kV):

The high acceleration voltage and high beam-efficiency of the 80 mm × 100 mm rectangular CRT ensures a bright trace for high speed sweep observation.

(4) Multi-mode display system:

CH1. CH2. ADD. CH3 (trigger view) any combination or all the channels may be viewed simultaneously with a simple adjustment of the MULTI-MODE display buttons. Maximum 8 trace displaying is possible with the ALT sweep function.

(5) Dynamic bias circuitry (PAT. PEND):

The energy-saving design makes use of automatic electric power consumption control circuitry so that, when the indicated signal waveforms are small or the frequency components are low operations are performed with minimum use of electricity.

(6) High stability and low-drift:

The new circuits are desinged and adopted with a temperature drift-compensation circuitry for minimizing any kind of drift and stable DC balance.

(7) High sensitivity and wide frequency bandwidth:

The maximum vertical sensitivity is 1 mV/DIV (with 5 ×MAG) 20 MHz or greater -3 dB and 5 mV/DIV at 60 MHz or greater -3 dB.

(8) High input impedance:

The input impedance of CH1, CH2, CH3 (trigger view) is 1 MΩ ±1%, 25 pF ±2 pF, allowing the use of 10× probes.

(9) "VERT MODE" TRIGGER FUNCTION:

When in the VERT MODE trigger mode, stable triggering can be attained even when the signals of CH1, CH2 are not time related.

(10) Maximum sweep speed 5 ns/DIV:

With ×10MAG function the highest sweep speed of 50 ns/DIV can be multiplied by a factor of 10 to a attain a maximum sweep speed of 5 ns/DIV.

(11) Alternate sweep:

The A sweep and the delayed sweep can be viewed simultaneously in the alternate mode.

(12) 2 channel X-Y operation:

CH3 may be used as EXT HORIZ input allowing CH1 and CH2 to be used as vertical inputs for DUAL channel X-Y displays.

(13) Trigger level lock:

A new trigger level lock circuit which controls the trigger signal and performs automatic adjustments of the trigger level, even for VIDEO signals and signals of large duty cycles. This is an operation step-saver which eliminates the need for manual trigger level adjustment.

(14) TV sync. triggering:

The COS5060 has a sync separator circuit, which allows triggering for TV.V signal and TV.H signal. It is automatically switched with the TIME/DIV control.

(15) Variable holdoff function:

Digital and other signals with complex repeating periods which resist triggering can be stably triggered with a simple adjustment of the hold off level.

(16) Linear focus:

Once the beam focus is adjusted, it is automatically maintained in this state regardless of changes in intensity.

(17) CH1 signal output:

The CH1 signal output allows connection to frequency counters and other devices at all levels.

2. SPECIFICATIONS

Vertical axes

Item	Specification	Remarks
CH1 and CH2		
Sensitivity	5 mV/DIV - 5 V/DIV 1 mV/DIV - 1 V/DIV (when ×5 MAG)	1-2-5 sequence, 10 positions
Sensitivity accuracy	±3% ±5% (when ×5 MAG)	10 to 35°C (50 to 95°F), at 8 DIV
Variable vertical sensitivity	To 1/2.5 or less of panel-indicated value	
Frequency bandwidth	DC - 60 MHz (-3 dB) DC - 20 MHz (-3 dB), when ×5 MAG AC coupling: Low limit frequency 10 Hz	With reference to 50 kHz, 8 DIV.
Input coupling	AC, DC, GND	
Input impedance	1 MΩ ±1%, 25 pF ±2 pF	
Allowable input voltage	400 V (DC + AC peak)	Frequency 1 kHz or lower
Square wave characteristics	Overshoot: Not greater than 5% (at 5 mV/DIV range) Other distortions: Not greater than 3% (at 5 mV/DIV range)	Other ranges: Add 3% VARIABLE knob is CAL'D position. 10 to 35°C (50 to 95°F)
CH3	EXT input terminal used in common.	
Sensitivity	0.1 V, 1 V/DIV	
Sensitivity accuracy	±3%	10 to 35°C (50 to 95°F), at 8 DIV
Frequency bandwidth	DC - 60 MHz (-3 dB) AC coupling: Low limit frequency 10 Hz	With reference to 50 kHz, 8 DIV.

Item	Specification	Remark
Input coupling	AC, HF REJ, TV, DC	
Allowable input voltage	100 V (DC + AC peak)	Frequency 1 kHz or lower
Square wave characteristics	Overshoot: Not greater than 10% Other distortions: Not greater than 5%	10 to 35°C (50 to 95°F)
Rise time	Approx. 6 nsec (Approx. 17.5 nsec when ×5 MAG)	
Signal delay time	Approx. 40 nsec (with delay cable of approx. 120 nsec)	The displayed portion preceding the triggering point
Delay time differences among channels	Not greater than ±0.5 nsec among CH1, CH2 and among another channel ±2.0 nsec	
Polarity change	CH2 only	
DC balance shift	±0.5 DIV (±2.0 DIV when in ×5 MAG)	
Display modes	Simultaneous displays of CH1, ADD (CH1 + CH2), CH2, CH3 are possible in any combination. ALT, CHOP: Switchable X-Y: TIME/DIV switch change to [X-Y] [CH3 HOR] and SOURCE switch to [X-Y].	Simultaneous X-Y displays of CH1, CH2, ADD and CH3, at CHOP MODE
Chopping repetition frequency	1 MHz/ number of displayed channels ±40%	
Common mode rejection ratio	50:1 or better at 50 kHz, sinusoidal wave	When sensitivities of CH1 and CH2 are set equal
CH1 signal output	Approx. 50 mV/DIV at 50Ω termination	Approx. 100 mV/DIV at open
CH2 INV BAL	Balanced point. Not greater than 1 DIV	Reference at center graticule

Item	Specification	Remark
Isolation between channels	At least 1000:1 at 50 kHz At least 30:1 at 60 MHz	At 5 mV/DIV range
Linearity	Within ±0.1 DIV when signal with 2 DIV amplitude in screen center is moved to upper or lower.	

Triggering

Item	Specification	Remark
Internal trigger selection (INT TRIG)	CH1, CH2 and "VERT MODE" (Trigger source is selected depending on the vertical operation mode.) When in ADD, the CH1 input signal is used at the trigger source signal.	VERT MODE function works in ALT sweep MODE between CHs and single CH alone operation
A trigger		
Signal source	INT, LINE, EXT, EXT/10	
Coupling	AC, HF REJ, TV, DC	
Polarity	+ or -	
Sensitivity	DC - 10 MHz: 0.4 DIV (0.04 V) 10 - 60 MHz: 1.5 DIV (0.15 V) Video signal: 2.0 DIV (0.2 V) AC coupling: Attenuates signal components of lower than 10 Hz. HF REJ: Attenuates signal components of higher than 50 kHz.	The values enclosed in the parenthese are the input sensitivities when in the EXT trigger mode.
B trigger		
Signal source	B trigger source is A trigger source.	

Item	Specification	Remarks
EXT trigger input	CH3 input terminal used in common	
Input impedance	1 MΩ ±2%, 25 pF ±2 pF	
Maximum allowable input voltage	100 V (DC + AC peak)	Frequency 1 kHz or lower
AUTO mode	Satisfies the trigger sensitivity specification for signal repetition frequency of 50 Hz or over.	
LEVEL LOCK	Satisfies the value of the above trigger sensitivity plus 0.5 DIV (0.05 V) for signal of duty cycle 20:80 and repetition frequency 50 Hz - 50 MHz.	

Horizontal axis

Item	Specification	Remarks
Horizontal axis display	A, ALT (A INT), B (DLY'D)	
A sweep		
Sweep mode	AUTO, NORM, SINGLE	
Sweep time	0.05 µsec/DIV - 0.5 sec/DIV 5 nsec/DIV - 50 msec/DIV (when in "×10 MAG")	1-2-5 sequence, 22 positions
Sweep time accuracy	±3%	10 to 30°C (50 to 95°F)
Variable sweep time	To 1/2.5 or slower of panel-indicated value	
Holdoff time	Continuously variable to 2 times or over of sweep length (time) at 0.05 µsec/DIV - 10 msec/DIV ranges	

Item	Specification	Remarks
B sweep		
Delay system	Continuous delay or triggered delay	
Sweep time	0.05 µsec/DIV - 50 msec/DIV 5 nsec/DIV - 5 msec/DIV (when in "×10 MAG")	1-2-5 sequence, 19 positions
Sweep time accuracy	±3%	10 to 35°C (50 to 95°F)
Delay time	0.5 µsec - 5 sec	
Delay time accuracy	±3% of multidial-indicated value (except 0 - 0.50) ±4% of value read on graticule	
Delay jitter	1/10,000 or less $\frac{\text{B sweep time}}{\text{A sweep time}} \times \frac{\text{jitter width}}{10\ \text{DIV}}$	Jitter width 1.0 DIV or less at A: 1 msec/DIV B: 1 µsec/DIV
Sweep magnification	10 times (maximum sweep time 5 nsec/DIV)	Both A and B
Magnified sweep time accuracy	0.1 µsec/DIV - 0.5 sec/DIV ranges: ±5% 0.05 µsec/DIV range: ±8%	10 to 35°C (50 to 95°F)
Linearity	±3% ±5% (when in "×10 MAG)	
CH3 sweep (CH3 HOR)	CH3 (EXT TRIG) input signal is used as sweep trigger signal. (For vertical axes, any combination of CH1, ADD (CH1 + CH2), CH2, and CH3 can be simultaneously displayed in CHOP mode.)	
Sensitivity	0.1 V, 1 V/DIV	Same as CH3
Sensitivity accuracy	±3%	Same as CH3

Item	Specification	Remarks
Frequency bandwidth	DC - 2 MHz (-3 dB)	With reference to 50 kHz, 10 DIV
Phase difference between vertical axes	Not greater than 3° at DC - 100 kHz	
X-Y mode	X-axis: CH1 input signal Y-axis: CH2 input signal	
Sensitivity	5 mV - 5 V/DIV	Same as CH1
Sensitivity accuracy	±4% NORM ±5% (when in "×10 MAG")	10 to 35°C (50 to 95°F)
Frequency bandwidth	DC - 2 MHz (-3 dB) AC coupling: Low limit frequency 10 Hz	With reference to 50 kHz, 10 DIV
X-Y phase difference	Not greater than 3° at DC - 100 kHz	

Z axis

Item	Specification	Remarks
Sensitivity	3 Vp-p (Trace becomes brighter with negative input.)	
Frequency bandwidth	DC - 5 MHz	
Input resistance	5 kΩ ±10%	
Allowable input voltage	50 Vp-p (DC + AC peak)	AC: 1 kHz or lower

Calibration voltage

Item	Specification	Remarks
Waveform	Positive-going square wave	
Frequency	1 kHz ±5%	
Duty ratio	Within 45:55	
Output voltage	2 Vp-p, ±2%	
Output resistance	Approx. 2 kΩ	

CRT

Item	Specification	Remarks
Type	6-inch rectangular CRT, internal graticule	
Fluorescent screen	P31 phosphor	
Acceleration voltage	Approx. 12 kV	
Effective screen size	8 × 10 DIV	1 DIV = 10 mm (0.39 in.)
Graticule	Internal graticule, continuously adjustable illumination	

Mechanical specifications

Item	Specification	Remarks
Dimensions of mainframe	280 W × 150 H × 370 D mm (11.02 W × 5.91 H × 14.56 D in.)	
Maximum dimensions	340 W × 190 H × 440 D mm (13.39 W × 7.48 H × 17.31 D in.)	
Weight	Approx. 7 kg (15 lbs)	

o Line power requirements

Voltage: 100 V, 115 V, 215 V, 230 V; with 10% allowance.
Selectable by connector change

Frequency: 50 Hz or 60 Hz

Wattage: Approx. 40 VA

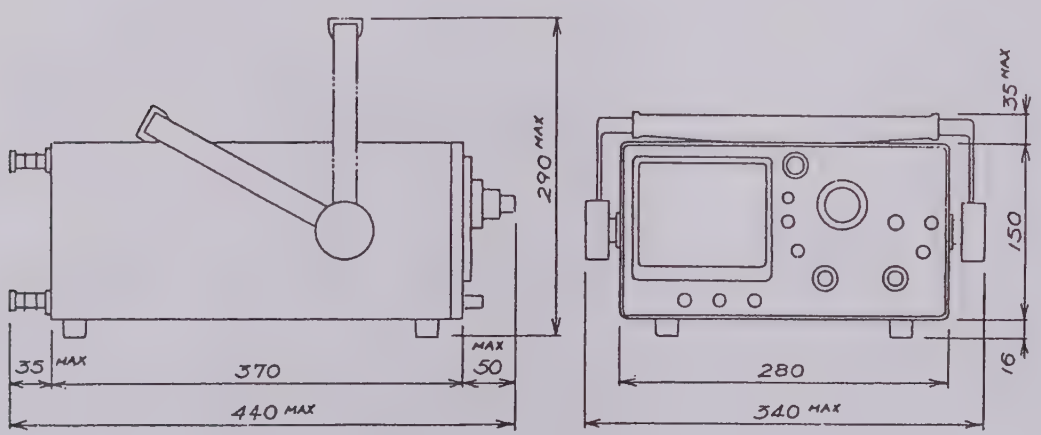
o Operating environment

To satisfy specifications: 5 to 35°C (41 to 95°F), 85% RH

Maximum operating ranges: 0 to 40°C (32 to 104°F), 90% RH

o Accessories

960 BNC probes (10:1, 1:1, 1.5 m) ...	(89-03-0220)	... 2
942A terminal adaptors	(W4-986-011)	... 3
Fuse (1 A or 0.5 A)	(99-02-0100) (99-02-0101)	... 1
Power cord	(85-10-0120)	... 1
Instruction manual	( )	... 1



o Specifications and contents on this manual are subject to change without notice.

3. CIRCUIT DESCRIPTION

3.1 General

The overall circuit structure of the oscilloscope is as depicted with a block diagram in Figure 3-1. It is comprised of a vertical deflection circuit for moving the beam spot in the Y-axis direction on the CRT screen, a horizontal deflection circuit for moving the beam spot in the X-axis direction, a CRT circuit for operating the cathode-ray tube, a calibrator circuit for calibrating the instrument probe, and a power supply circuit for supplying powers to the various circuits of the instrument.

The vertical amplifier circuit has two mutually independent preamplifiers (CH1 and CH2), a vertical switching circuit, a delay line, and a vertical output amplifier.

Each of the preamplifiers amplifies or attenuates its input signal of several millivolts to several hundreds volts into a level suitable for handling by the subsequent stages. The conditioned vertical signals are sent to the vertical switching circuit. The trigger signals also are picked off at this stage.

The vertical switching circuit electronically switches the vertical signals received from the CH1 and CH2 preamplifiers and the CH3 signal received from the trigger generator. The switched signal is fed via the delay line circuit to the vertical output amplifier. The trigger signals also are switched and fed as internal trigger signals to the trigger generator.

The vertical output amplifier amplifies the vertical signal, which is received through the delay line circuit, into a level of several volts to several tens volts for vertically deflecting the beam spot on the CRT screen.

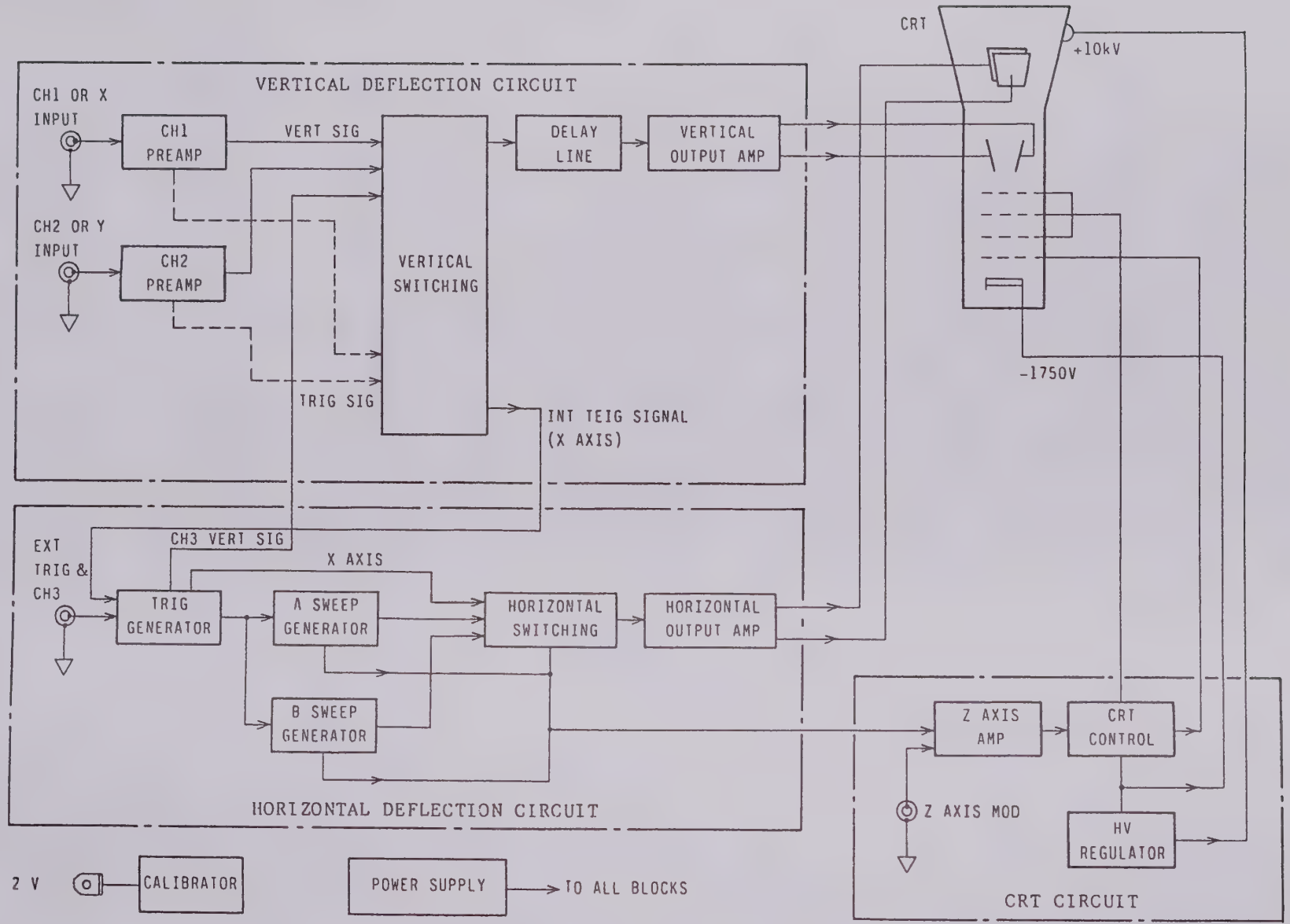

VERTICAL DEFLECTION CIRCUIT
CH1 OR X INPUT
CH1 PREAMP
VERT SIG
DELAY LINE
VERTICAL OUTPUT AMP
CH2 OR Y INPUT
CH2 PREAMP
VERTICAL SWITCHING
TRIG SIG
INT TEIG SIGNAL (X AXIS)
CRT
+10kV
-1750V
EXT TRIG & CH3
CH3 VERT SIG
X AXIS
TRIG GENERATOR
A SWEEP GENERATOR
B SWEEP GENERATOR
HORIZONTAL SWITCHING
HORIZONTAL OUTPUT AMP
HORIZONTAL DEFLECTION CIRCUIT
Z AXIS AMP
CRT CONTROL
Z AXIS MOD
HV REGULATOR
CRT CIRCUIT
2 V
CALIBRATOR
POWER SUPPLY
TO ALL BLOCKS

Figure 3-1

The horixontal deflection circuit has a trigger generator, sweep generator, a horizontal switching circuit, and a horizontal output amplifier.

The trigger generator receives the internal trigger signal from the vertical switching circuit or an external trigger signal from the EXT TRIG (CH3) INPUT terminal and amplifies the signal and generates a trigger pulse signal.

The A sweep generator is driven by the trigger pulse signal of the trigger generator and produces the A sawtooth signal. The sweep generator produces a sawtooth signal even when no trigger pulse is applied to it (the AUTO mode).

The B sweep generator produces the B sawtooth signal, being driven by the delayed sweep start signal produced with respect to the A sawtooth signal when in the continuous delay mode (HOR DISPLAY: B). When in the synchronized delay mode (HOR DISPLAY: B TRIG'D), the B sweep generator generates the B sawtooth signal being driven by the trigger pulse signal of the trigger generator which follows the above delayed sweep start signal.

The horizontal switching circuit electronically switches the sawtooth signals received from the A and B sweep generators and the CH1 & CH3 HOR signal received from the vertical switching circuit when in the X-Y mode of operation, and sends the resultant signal to the horizontal output amplifier.

The horizontal output amplifier amplifies the output signal of the horizontal switching circuit to a level of several volts to several tens volts in order to drive horizontally the beam spot on the CRT screen.

The CRT circuit is comprised of a high voltage generator (the HV regulator) to accelerate the electron beam emitted from the CRT cathode, a Z-axis amplifier to amplify the signal to blank out the return traces, and a CRT control circuit to operate the CRT tube in its optimal state.

The HV regulator provides a -1.8 kV voltage which is applied to the CRT cathode to accelerate the electrons emitted by it and a 10 kV voltage which is used as a post-acceleration voltage to accelerate further the electrons after passing the vertical and horizontal deflection plates.

The Z-axis amplifier amplifies the unblanking signals received from the A and B sweep generators and the trace intensity control signal to a level of several tens volts in order to be applied to the 1st grid (control grid) of the CRT via the CRT circuit.

The CRT circuit provides the various voltages for the CRT electrodes so that the CRT operates in an optimal state, displaying sharply-focussed less-distorted signal waveforms. It also conditions the signals received from the Z-axis amplifier and other circuits into levels suitable for application to the CRT.

3.2 Preamplifiers

The CH1 preamplifier amplifies the signal of the CH1 or X input terminal. The CH2 preamplifier amplifies the signal applied to the CH3 or Y input terminal. A detailed block diagram is shown in Figure 3-2.

- Input coupling switch:

The input coupling switch (S101/S201) selects the input coupling mode for AC, GND, or DC. When the GND state is selected, the preamplifier input is isolated from the input terminal and is grounded so that the base line (0 level) on the CRT screen can be checked.

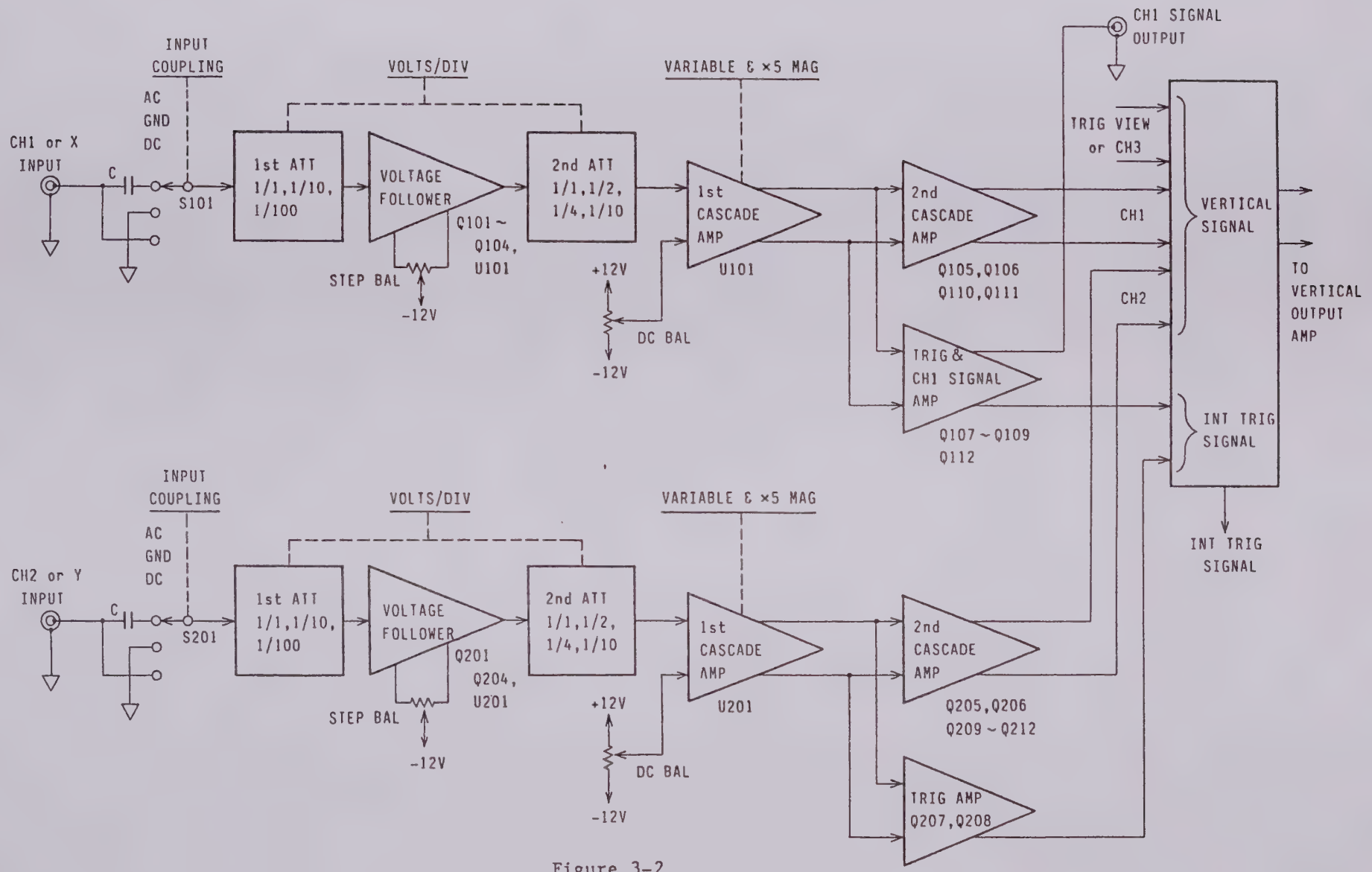

CH1 SIGNAL OUTPUT
INPUT COUPLING
AC
GND
DC
VOLTS/DIV
VARIABLE & ×5 MAG
CH1 or X INPUT
C
S101
1st ATT 1/1,1/10, 1/100
VOLTAGE FOLLOWER
Q101 ~ Q104, U101
STEP BAL
-12V
2nd ATT 1/1,1/2, 1/4,1/10
+12V
DC BAL
-12V
1st CASCADE AMP
U101
2nd CASCADE AMP
Q105,Q106
Q110,Q111
TRIG VIEW or CH3
CH1
CH2
TRIG & CH1 SIGNAL AMP
Q107 ~ Q109
Q112
VERTICAL SIGNAL
TO VERTICAL OUTPUT AMP
INT TRIG SIGNAL
INT TRIG SIGNAL
CH2 or Y INPUT
S201
Q201 Q204, U201
U201
Q205,Q206
Q209 ~ Q212
TRIG AMP
Q207,Q208

Figure 3-2

o Attenuators:

Each of the CH1 and CH2 attenuator circuits consists of two attenuators: The 1st attenuator for 1/1, 1/10 and 1/100, and the 2nd attenuator for 1/1, 1/2, 1/4 and 1/10. By switching these attenuators with the VOLTS/DIV switch (S102/202), the signal can be attenuated for a total range of 1/1 to 1/1000 in 10 steps.

The 1st attenuator directly attenuates the signal received from the input coupling switch and feeds the attenuated signal to the voltage follower. The 2nd attenuator attenuates the low-impedance output signal of the voltage follower and feeds the attenuated signal to the 1st differential cascade amplifier.

o Impedance converter:

The impedance converter provides with its source follower (Q101/Q201) a high input impedance to prevent the loading effect on the high-impedance attenuator circuit and provides a low output impedance with its emitter follower (CH1 and CH2) to drive the 1st differential cascade amplifier of the next stage. In order to guard against thermal drift, the source follower employs a dual-FET package which houses two thermally-coupled elements for thermal drift compensation and the emitter follower employs two premium-grade thermally-coupled transistors.

o 1st differential cascade amplifier:

The 1st differential cascade amplifier is comprised of an emitter-connected differential current amplifier (U102-1/2, U202-1/2) and a current-to-voltage converter (U102-2/2, U202-2/2) which converts the differential collector output current of the differential current amplifier into a voltage signal. This amplifier also has the VARIABLE circuit for continuously variable adjustment of the sensitivity between two adjoining vertical deflection sensitivity ranges selected by the VOLTS/DIV switch and the ×5MAG switch for magnifying the vertical sensitivity by 5 times to realize the 1 mV/DIV sensitivity.

o VARIABLE circuit:

The VARIABLE circuit continuously-variably adjusts the vertical sensitivity by shunting with potentiometer RV105/RV205 a part of the collector current amplified by U102-1/2 or U202-1/2. Adjustment (attenuation) can be done with a ratio of 1/2.5 or over.

o ×5MAG circuit:

The ×5MAG function is to increase the vertical sensitivity by 5 times by switching the emitter resistor of the 1st differential cascade amplifier.

o 2nd differential cascade amplifier:

The 2nd differential cascade amplifier (Q105, 106, 110, 111, or Q205, 206, 209 - 212) amplifies the output of the 1st differential cascade amplifier to a sufficient level for driving the vertical switching circuit. The grounded-base stage (Q110, 111/Q209 - 212) of this cascade amplifier has a function of preventing the switching signal of the vertical switching circuit from being returned to the preceding stage and mixed into the trigger signal or the signal of the CH1 signal output amplifier. For the CH2 signal, this amplifier also has a function of inverting its polarity. This polarity inverting function is accomplished by switching with the INV switch the base grounding stages of Q209/210 and Q211/212 to which the collector currents which have been current-amplified by Q205 and Q206 are fed in a crossing manner.

Different from the case of the 1st differential cascade amplifier, the output signal of the 2nd differential cascade amplifier is fed directly in the form of the current signal to the diode gate of the vertical switching circuit. The current signal for vertical positioning of the trace on the CRT screen is added to the output current signal of the 2nd differential cascade amplifier, being controlled by potentiometer RV109/209 of the positioning circuit.

o Trigger signal amplifier (& CH1 signal output amplifier):

This circuit amplifies with its Q107, 108/Q207, 208 the signal picked off from the 2nd differential amplifier, and converts with its Q109 the collector output of Q107 into a low-impedance CH1 output signal which is fed to J-8C. The collector output signal of Q108/Q208 is fed as a trigger signal to the internal trigger switching circuit.

3.3 Vertical Switching Circuit

The vertical switching circuit is comprised of a vertical signal switching circuit (diode gate circuit) which electronically switches the vertical signals received from the CH1 and CH2 preamplifiers and the CH3 signal received from the TRIG generator, an internal trigger signal switching circuit which electronically switches the trigger signals, and a switching logic circuit which controls these switching circuits.

The vertical signal switching circuit is, as shown in Figure 3-3, comprised of a diode gate circuit, an ADD BAL circuit, and a switching buffer circuit which receives the signal from the diode gate circuit.

o Diode gate circuit:

The diode gate circuit (CR102 - 105, CR201 - 204, CR301 - 304) selects the CH1 - CH3 signals being controlled by the signal of the switching logic circuit according to the mode selected by the VERT MODE switch (S501).

For example, when the VERT MODE switch is set at CH1, the CH1 control signal becomes the Hi state, and the CH2 and CH3 control signals become the Lo state. Consequently the output signal of the CH1 preamplifier is fed through CR104 and CR105 to the switching buffer circuit consisting of Q403 and Q404. The signals of the other channels are fed through respective diodes CR202/203 and CR302/303 to the control circuit. Thus, the signal of CH1 alone is fed to the switching buffer circuit and the signals of the remaining channels are blocked.

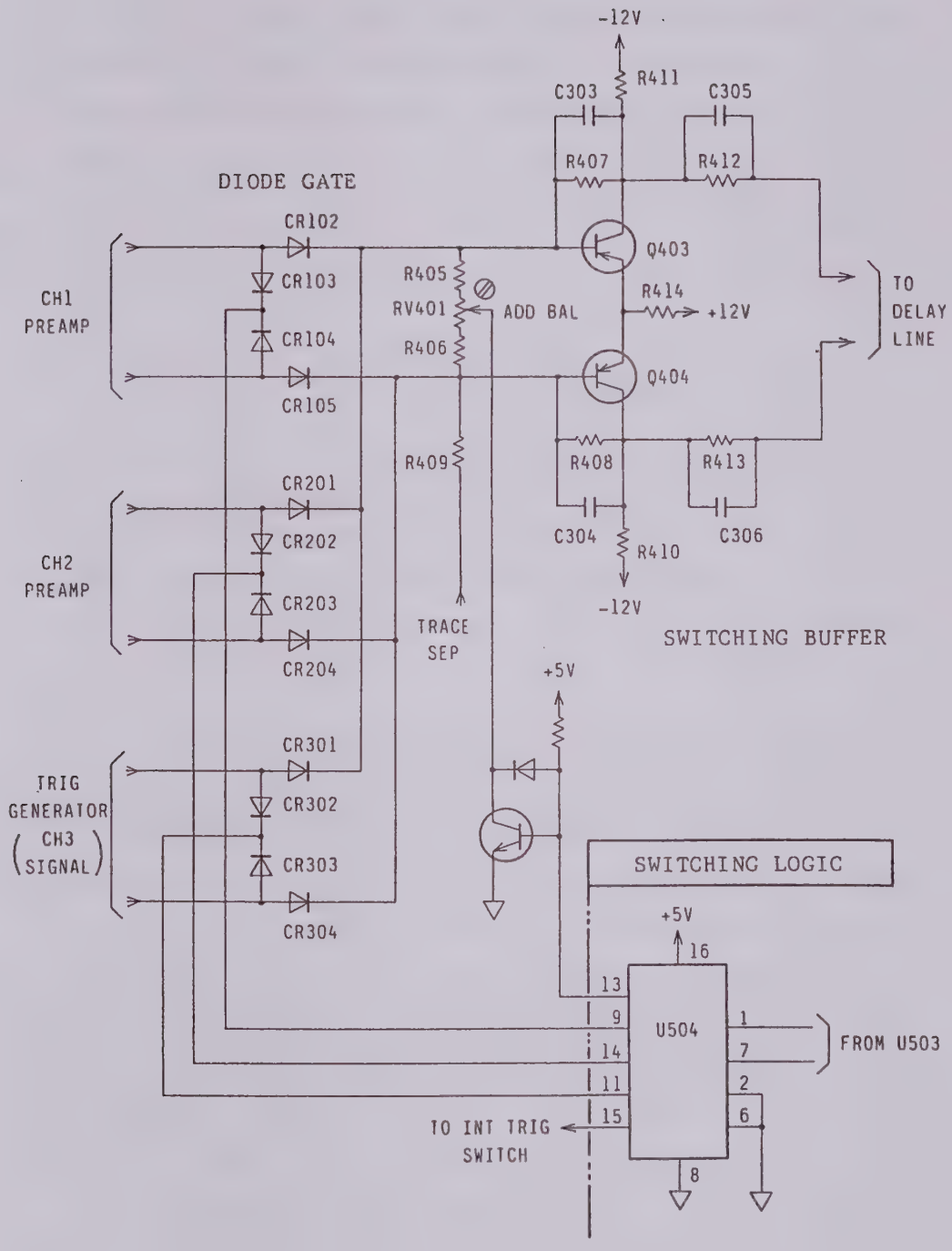


Figure 3-3 Vertical switching circuit

o ADD BAL circuit:

When the ADD mode is selected by the VERT MODE switch, the control signals of both CH1 and CH2 become the Hi state, the signals of the CH1 and CH2 preamplifiers are fed through CR104/105 and CR201/204 to the switching buffer circuit, and the two signals are fed as their sum signal to the output circuit. The function of the ADD BAL circuit is to compensate for the DC balance shift caused by the above addition operation, with its ADD BAL control (semi-fixed potentiometer RV401).

o Internal trigger signal switching circuit:

The internal trigger signal switching circuit directly controls, with the control signals from the switching logic circuit, the diode gate circuit (CR205 - 208) which is similar to the vertical signal switching circuit. The trigger signal which has passed the diode gate circuit is delivered as the internal trigger signal via connector P-10.

o Switching logic circuit:

The switching logic circuit is comprised of a vertical switching logic circuit which controls the vertical signal switching circuit and an internal trigger switching logic circuit which controls the internal trigger signal switching circuit.

The vertical switching logic circuit is comprised of a ring counter which is consisting of two flip-flops (U503-1/2, 2/2) with preset/clear terminals and a code converter (U504) which receives the ring counter output and generates control signals for individual channels. Switching can be done for any combination of channels by turning on and off the preset/reset terminals of the ring counter. The code-converted control signal is fed to the internal trigger switching logic circuit.

The internal trigger switching logic circuit controls the internal trigger switching circuit by switching with IC U505 the control signal selected by the INT TRIG switch (S502) and the control signal received from the vertical switching logic circuit. This relationship is shown in the following table.

MODE / INT TRIG	CH1	ADD	CH2	TRIG VIEW / CH3
CH1	Triggered by CH1			
CH2	Triggered by CH2			
VERT MODE	Trig'd by CH1	Trig'd by CH1	Trig'd by CH2	Trig'd by CH1

*: The triggering functions of VERT MODE are effective only when in a single-channel display or in a multiple-channel display in the ALT mode. They remain idle when in the CHOP mode.

3.4 Delay Line Circuit

The vertical signal which has passed the diode gate circuit is amplified by the switching buffer circuit (Q403, Q404). The switching buffer circuit drives the delay line, with a matched output impedance.

The delay line is used to prevent the trigger point of the signal from being lost from being displayed on the screen due to time lag in the horizontal deflection circuits or the Z-axis amplifier circuits. For the delay line, this oscilloscope employs a delay cable which provides a delay time of approximately 100 nanoseconds. The vertical signal which has passed the delay line is fed to the vertical output amplifier.

3.5 Vertical Output Amplifier

The vertical output amplifier is comprised of a delay line receiver which receives the output signal of the delay line with a matched impedance, and a final amplifier which drives the vertical deflection plates of the CRT.

- Delay line receiver circuit:

The delay line receiver circuit (Q410, 411) is a low input impedance negative feedback amplifier which, with its input resistors R422 and R423, provides impedance matching with the characteristic impedance (Zo ≒ 186 ohms) of the delay line.

- Final amplifier:

The final amplifier boosts the signal to a level sufficient for driving the vertical deflection plates of the CRT. It is comprised of a pair of feedback-type SEPP amplifiers.

Transistors Q412, 413/Q414, 415 current-amplify the signal to a level sufficient for driving transistors Q417, 418/Q419, 420. The signal which has been voltage-amplified by transistors Q417, 418/Q419, 420 is returned to the input circuit through the negative feedback circuit (R435/R436). The gain in this case is as follows:

$$Av = \frac{R435}{R428} \qquad Av' = \frac{R436}{R429}$$

Transistors Q416/Q421 are for the dynamic bias circuit which controls the bias current with respect to the repetition frequency of the signal in order to economize current consumption.

3.6 Trigger Generator

The trigger generator is comprised of a trigger pulse generator circuit which produces a trigger pulse signal for driving the sweep generator and an AUTO circuit which produces a free-run signal for automatic sweep operation when the trigger signal is asynchronized or no trigger signal is applied.

The trigger pulse generator circuit of the trigger generator is comprised of a source switch which selects a trigger signal source, a coupling switch which selects a coupling mode in conformity with the nature of the trigger signal source, an impedance converter circuit which converts the high-impedance trigger source signal into a low-impedance signal with which to drive the level comparator circuit which controls the start point (triggered point) of the signal waveform displayed on the CRT screen, a TV synchronization separator circuit which picks off the synchronization signal from the TV video signal, and Schmitt trigger circuits which convert the output signals of the level comparator circuit and TV synchronization signal separator circuit into TTL level signals.

- Source switch:

The source switch (S502) selects the internal trigger signal fed from Q510, the line trigger signal fed from R585, the external trigger signal fed directly from J-61C, or the signal fed from J61C through the 1/10 attenuator in order to be converted into the EXT ÷ 10 TRIG signal. The selected signal is fed to the coupling switch.

- Coupling switch:

The coupling switch (S503) selects the coupling mode: It selects the DC mode for direct coupling of the signal fed from S502, the AC mode for discarding the DC component, or the HF REJ mode for coupling via a low-pass filter. Switch S503 selects ON or OFF of the TV synchronization signal separator circuit which facilitates observation of a TV video signal.

o Impedance converter:

The impedance converter is a temperature-compensated-type cathode follower (Q512) with dual FET's. It converts the trigger signal selected by the source switch and coupling switch into a low-impedance signal. The impedance is lowered further by the emitter follower of U510 and then the signal is fed to drive the level comparator circuit.

It also delivers the TRIG VIEW and CH3 signals from its U510 Pins Nos. 8 and 11.

o Level comparator:

The level comparator is a differential cascade amplifier (U510, Q513, Q514) which adjusts the rise up portion (or the fall down portion) of the comparator output signal by applying to U510 Pin No. 9 of the current amplifier stage the trigger source signal from the impedance converter circuit and adding to U510 Pin No. 6 the comparator level signal from the LEVEL control potentiometer (RV501-1). In this case, if switch S503 which is linked to the LEVEL control potentiometer is locked, the comparator level signal is applied to U501 Pin No. 6 from the level lock circuit and the trigger point is fixed at the center amplitude of the trigger source signal.

The level lock circuit amplifies with its error amplifier (U511) the error signal detected by Q515 and Q516, and feeds back the signal so that the center level of the comparator output signal becomes the Schmitt level of the Schmitt trigger circuit.

It also selects a slope by switching the polarity of the output signal of the cascade amplifier (U501) with the diode switch circuit.

The output signal of the cascade amplifier is fed via the buffer amplifier which is used also as a TV synchronization signal separator circuit.

- Buffer amplifier/TV synchronization signal separator circuit:

  This circuit operates either as a buffer amplifier or as a TV synchronization signal separator circuit, being selected by the transistor switching circuit (Q517, 518).

  When Q517 is on and Q518 is off, the circuit operates as a buffer amplifier and amplifies the output signal of the level comparator to a level sufficient for driving the Schmitt circuit of the next stage.

  When Q517 is off and Q518 is on, the circuit operates as a TV synchronization signal separator circuit and picks off the TV-H synchronization signal, which is pulsewidth-detected into a TV-V synchronization signal by the Schmitt circuit of the next stage.

- TRIG Schmitt circuit:

  The TRIG Schmitt circuit is a conventional one which generates a hysteresis voltage by applying a beedback signal with R567 to the two stages of NAND gates of U512. The output of the Schmitt circuit drives the A and B SWEEP generators and AUTO circuit.

- AUTO circuit:

  The AUTO circuit is comprised of a uni-junction transistor (UJT) circuitry made up by connecting mutually the bases and collectors of a PNP transistor (Q521) and an NPN transistor (Q522). This circuit converts the high-speed pulse output signal of the Schmitt circuit into a DC signal, which is conditioned for waveform-shaping by the gate circuit (U513) to drive the A sweep generator and the TRIG'D LED lamp.

3.7 A and B Sweep Generators

The A sweep generator produces the sawtooth signal for the main sweep (A sweep) of this oscilloscope. The B sweep generator produces the sawtooth signal for magnification in the time axis direction the waveform displayed on the main sweep or for display with a certain time delay (delayed sweep or B sweep).

The A sweep generator consists of the A sweep gate circuit which receives the trigger signal from the trigger generator and produces the sweep gate signal for starting sweeps, the sweep start comparator which maintains stably the sweep start point, the A sawtooth sweep generator which produces a sawtooth wave in conformity with the time constant selected by the TIME/DIV switch, the sweep length circuit which controls the length of sweeps, the hold off circuit which controls the sweep return period and pause period, and the A sweep gate enable circuit which controls the sweep gate circuit in conformity with the AUTO, NORM or SINGLE mode as selected by the MODE switch for the signals of the above control circuits.

o A sweep gate:

The A sweep gate circuit employs a flip-flop TTL IC (U602-1/2) with preset/clear function. The trigger pulse of the trigger generator is applied to the CLOCK (Pin No. 1) terminal, the enable signal of the A sweep gate enable circuit to the CLEAR (Pin No. 15) terminal, and the enable signal and AUTO signal of the AUTO circuit to the PRESET (Pin No. 4) terminal through the NOR gate circuit. The Q (Pin No. 5) terminal output is applied as the unblanking signal to the Z-axis amplifier and the $\overline{Q}$ (Pin No. 6) terminal output is fed to the sweep start comparator circuit and becomes the A sweep gate signal. Even when no trigger pulse signal is applied to the CLOCK terminal, the $\overline{Q}$ output can be made the low state with the AUTO signal of the PRESET terminal so that the A sweep gate signal is generated and the circuit operates in the free-run mode.

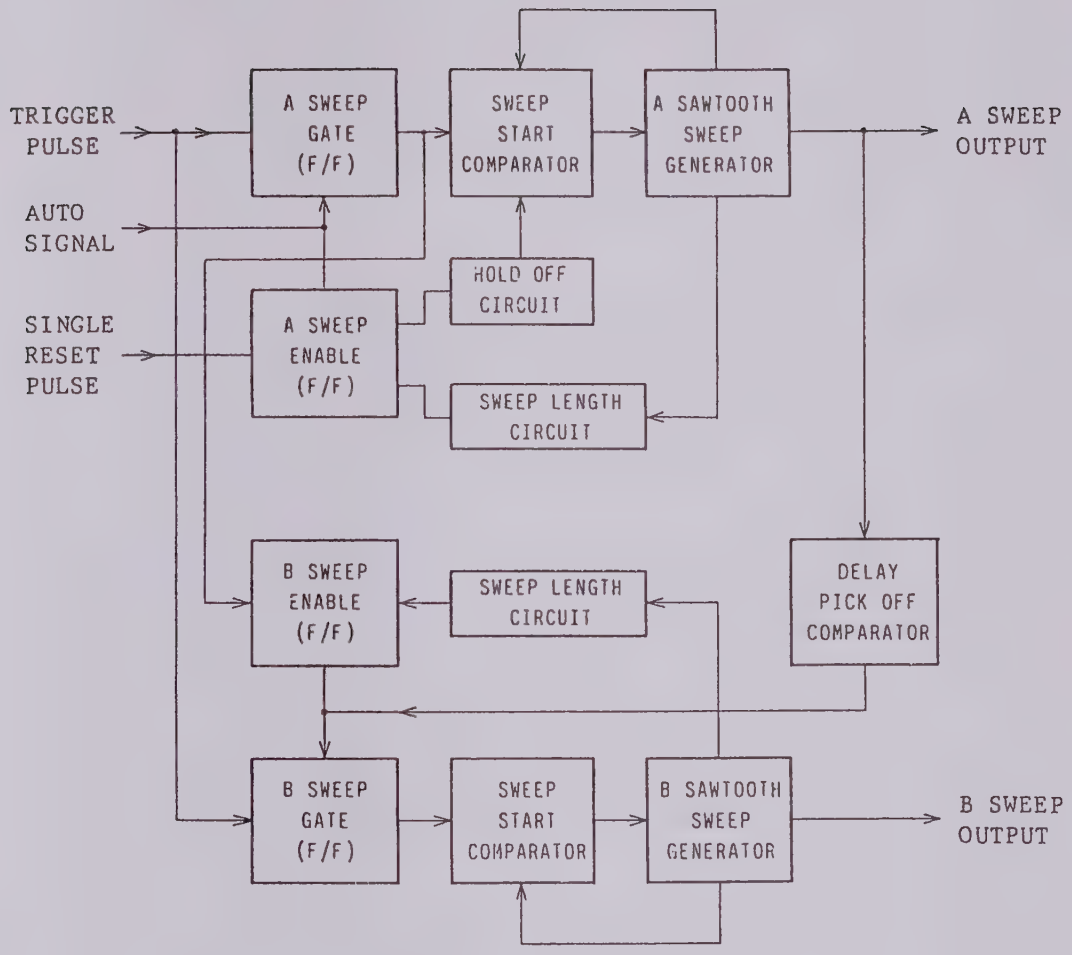

TRIGGER PULSE
AUTO SIGNAL
SINGLE RESET PULSE
A SWEEP GATE (F/F)
SWEEP START COMPARATOR
A SAWTOOTH SWEEP GENERATOR
A SWEEP OUTPUT
HOLD OFF CIRCUIT
A SWEEP ENABLE (F/F)
SWEEP LENGTH CIRCUIT
B SWEEP ENABLE (F/F)
SWEEP LENGTH CIRCUIT
DELAY PICK OFF COMPARATOR
B SWEEP GATE (F/F)
SWEEP START COMPARATOR
B SAWTOOTH SWEEP GENERATOR
B SWEEP OUTPUT

Figure 3-4

o Sweep start comparator:

The sweep start comparator (Q601, 602) is a differential amplifier which lets the sweep gate signal pass and maintains constant the sweep start level. A start reference level identical with the B sweep start level is applied to one of the inputs, the Miller integrator output signal is applied to the other input, and the difference between the two signals is compensated for.

o A sawtooth generator:

The A sawtooth generator is comprised of a gate transistor amplifier, a Miller integrator, an integration time constant switching circuit, and a TIME/DIV switch which controls the switching circuit. The gate transistor amplifier (Q604) controls the Miller integrator circuit in such manner that the start level control signal and sweep gate signal of the sweep start comparator do not affect the integration time constant. The Miller integrator (Q606, 607) produces a sawtooth signal with the time constant selected by the integration time constant selector circuit. The integration time constant selector circuit selects integration capacitor C609/C611 with Q605. For integration current, resistor array R671 is directly selected by the TIME/DIV switch (S604-2).

o Sweep length circuit:

The sweep length circuit divides with resistors R620 and R621, and shapes the waveform with Q612 to obtain a sweep length signal.

o Holdoff circuit:

The holdoff circuit generates a holdoff (pause) time signal proportional to the sweep time by producing a triangular wave with an integrator circuit and making use of the rise time of the triangular wave. The integrator, with its Q610, selects the time constant in accordance with the integration output voltage in order to cover a wide time range. The output signal of the integrator circuit is shaped by Q611 into a holdoff signal.

o A sweep gate enable circuit:

The A sweep gate enable circuit employs the flip-flop IC (U602-2/2) which makes up a pair with the A sweep gate circuit. The holdoff signal is applied to the PRESET (Pin No. 10) terminal, the length signal is applied to the CLEAR (Pin No. 14) terminal, and the enable signal is delivered from the Q (Pin No. 9) terminal. This enable signal presets or clears the A sweep gate circuit. When in the NORM sweep mode, the output signal of the AUTO circuit is blocked and, if no trigger signal is applied, the circuit is in the ready state. When in the SINGLE sweep mode, the holdoff circuit remains idle and a one-shot sweep is effected by the reset signal applied from the CLOCK (Pin No. 13) terminal.

The basic structure of the B sweep generator is identical with that of the A sweep generator. It consists of the B sweep gate, sweep start comparator, B sawtooth generator, sweep length circuit, B sweep enable circuit, and delay pickoff comparator. The B sweep generator requires no holdoff circuit because it operates only during the period the A sweep generator is in the sweep operation. Instead of the holdoff signal, the A sweep gate signal sets the B sweep enable circuit to the enable state.

o Delay pickoff comparator:

The delay pickoff comparator (Q613 - 615) employs a dual FET (Q615) to obtain a certain time relationship as set by the delay time multiplication potentiometer (RV605) with respect to the A sweep signal. The comparator compares the A sweep output signal (sawtooth waveform) with the voltage set by RV605, generates a delayed sweep start signal, and sets the B sweep gate circuit to start the B sweep signal. When in the B TRIG'D mode, the B sweep gate circuit is not set directly with this delayed sweep start signal but the PRESET (Pin No. 4) terminal is set to the high state and the B sweep signal is started as driven by the trigger pulse of the trigger generator.

3.8 Horizontal Switching Circuit

The horizontal switching circuit is comprised of a switching buffer circuit which prevents switching distortion from being sent to the sweep circuit of the preceding stage, a display switching circuit which electronically switches the A and B sweep signals and CH1 HOR (X) signal, and a display logic circuit to control these circuits.

- Switching buffer circuit:

The switching buffer circuit is of a grounded-base-type amplifier. Transistor Q608 is for buffer-amplification of the A sweep signal, transistor Q626 for the B sweep signal.

- Display switching circuit:

The display switching circuit, with its analog signal multiplexer IC (U607), selects the A and B sweep signals and CH1 HOR (X) signal.

- Display switching logic circuit:

The display switching logic circuit, with its flip-flop (U606-1/2) which has a preset/clear terminal, controls the display switching circuit in conformity with the operation mode selected by the HOR DISPLAY switch (S601). With its another flip-flop (U606-2/2), it generates the alternate switching pulse signal for the vertical axis circuits.

3.9 Horizontal Output Amplifier

The horizontal output amplifier consists of a drive amplifier which selects between NORM and ×10 MAG mode for the horizontal signal received from the horizontal switching circuit and drives the output amplifier, and an output amplifier which drives the horizontal deflection plates of the CRT.

o Drive amplifier:

The drive amplifier (Q701 - 704) converts the horizontal signal received from the horizontal switching circuit into a differential signal, with which to drive the output amplifier. With Q701 and 702, gain of the differential amplifier can be multiplied by a factor of 10 for the ×10 MAG function.

o Output amplifier:

The output amplifier (Q705 - 712) is comprised of feedback-type SEPP amplifiers symmetrical for right and left which provide sufficient speed and output voltage for driving the horizontal deflection plates of the CRT. The signal current-amplified by Q705/Q706 is converted into a voltage signal by Q707 - Q712 to obtain a sufficiently high gain and a sufficiently low output impedance. By means of negative feedback resistor R720/R721 a stable gain and wide and flat frequency response are attained.

3.10 Z-axis Amplifier

The Z-axis amplifier is comprised of an input circuit and an output amplifier. The input circuit merges the unblanking signals of the A and B sweep generators, the external intensity modulation signal applied through the Z-axis input terminal, the B intensity control signal, and the overall intensity control signal. The output amplifier amplifies the merged signal into a sufficient level for driving the G1 grid of CRT.

o Input circuit:

The input circuit merges the unblanking signals of the A and B sweep generators, the chopped blanking signal, the external intensity modulation signal applied via the X-axis input terminal, and the overall intensity control signal. The resultant compound signal is fed to the output amplifier.

o Output amplifier:

The output amplifier amplifies the above compound signal to several tens volts. It is of a feedback-type SRPP circuit (Q821, 822, 825). This amplifier also generates (with its Q823, 824, 826) a linear focus signal which is in the inverted phase of the unblanking signal. The amplified unblanking output signal and linear focus signal are fed to the G1 and P1 of the cathode-ray tube through the CRT circuit to drive the intensity and focus of the displayed waveform.

3.11 CRT Control Circuit

The CRT control circuit is comprised of a DC regeneration circuit which converts the linear focus signal and the unblanking output signal of the Z-axis amplifier into the operating-voltage signals of the CRT in order to be applied to the focus electrode and G1 electrode of the CRT, semi-fixed potentiometers ASTIG (RV822), GEOMETRY and SUB-FOCUS (RV820), a trace rotation circuit for adjusting the trace direction in parallel with the horizontal graticule lines, and an illumination circuit for illuminating the graticule.

o DC regeneration circuit:

The DC regeneration circuit converts the linear focus signal and unblanking signal of several tens to several hundreds volts into AC signals with the switching signal of the DC-DC converter circuit, and then converts them back into DC signals with respects to the cathode voltage and focus reference voltage of the sub-focus potentiometer in order to provide a focus signal and an unblanking signal of the operating voltages of the CRT.

3.12 HV Regulator (High Voltage Generator)

The high voltage generator produces an acceleration voltage (-1750 V) applied to the CRT cathode and a post-acceleration voltage (approximately +10 kV) applied to the CRT anode to accelerate the electrons beam which have passed the X and Y deflection plates and mesh electrode. The circuitry is a

DC-DC converter with blocking oscillator (Q820), with resonance of the secondary coil winding. The high voltage of approximately 3600 Vp-p (frequency approximately 30 kHz) generated by the blocking oscillator is 6-times voltage-multiplication rectified by a Cockcroft circuit into a positive voltage of approximately 18 kV and it is half-wave rectified into a negative voltage of -1750 V.

This DC-DC converter feeds the negative voltage of approximately 1800 V via a high resistance circuit (R862, R864) to the control circuit (U820) to obtain a stabilized acceleration voltage. It also is fed through a capacitor-coupling circuit to the DC regeneration circuit in order to be used as the switching signal.

3.13 Power Supply Circuit

The power supply circuit steps up or down with its power transformer the AC line voltage into various voltages and rectifies them to DC supply voltages for the various circuits of the oscilloscope. The primary winding of the power transformer is of a split type, in order that the oscilloscope can be operated on various AC line voltages by connecting the transformer taps in series or parallel as required by means of the line voltage selector plug (P-47). Regarding the secondary circuit, the transformer has one 6.3 V winding for the CRT heater and two windings of different voltages for different circuits of the CRT. The AC voltages of the two windings are rectifies and supplied as regulated +16 V power and non-regulated +145 V, +12 V, +5 V, and -12 V powers.

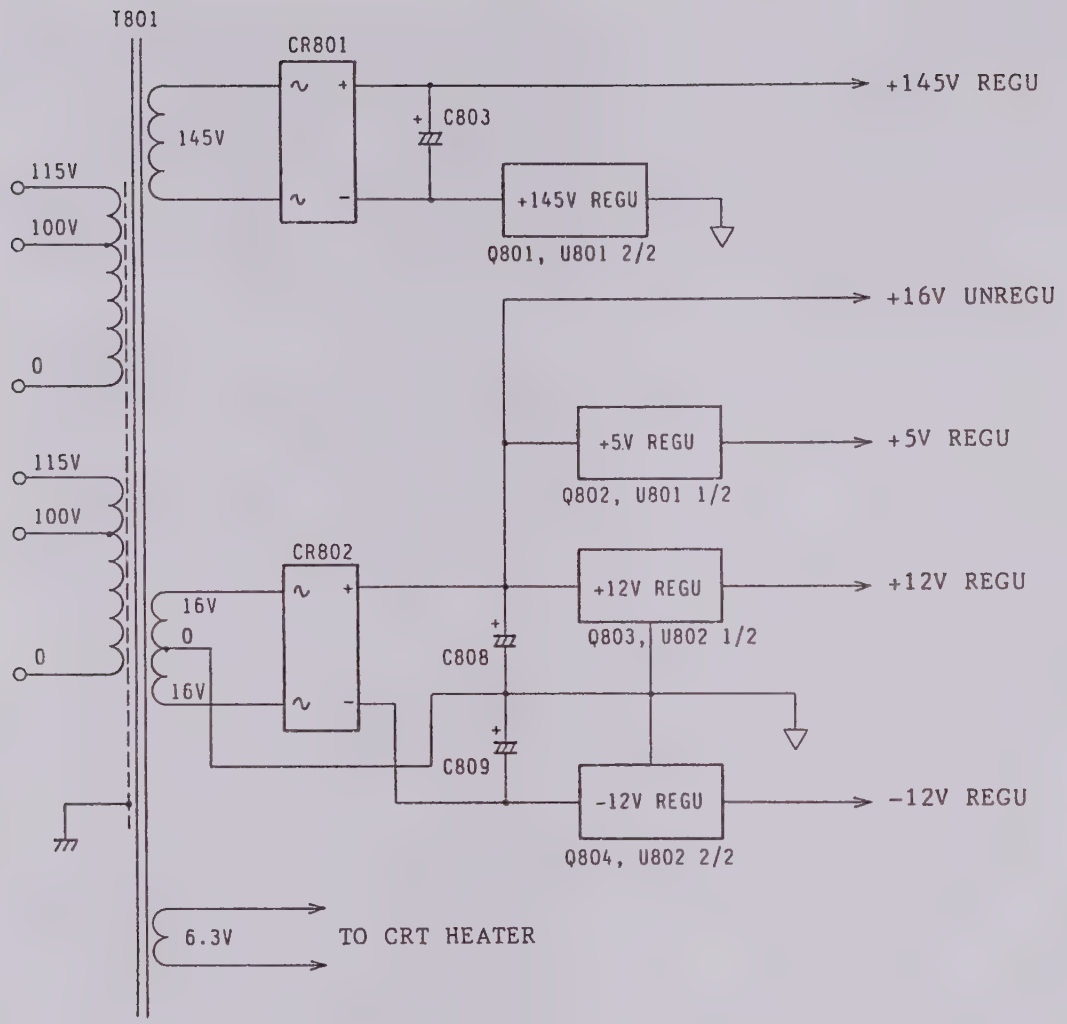


Figure 3-5

3.14 Calibrator Circuit

The calibrator circuit provides square-wave calibration voltage signal of 2 Vp-p which is used for calibration of the probe and the amplifiers when they are operated in the non-calibrated mode. The voltage accuracy of the calibration signals is 2% or better. The calibration signal is produced by generating a signal with the multivibrator of CMOS IC (U1601 1/4, 2/4), shaping the waveform with the Schmitt circuit of CMOS IC (U1601 3/4, 4/4), and dividing the voltage signal with resistors.

4. CALIBRATION

4.1 General

After the oscilloscope has been used for a period of time, it should be calibrated. Although calibration of overall performances is recommended, partial calibration may serve the purpose as that the time axis alone is calibrated when the time measuring accuracy is especially important or that the vertical axis alone is calibrated when the vertical sensitivity accuracy is of prime importance. After the oscilloscope has been repaired, overall calibration is suggested although it depends on the type of repair. For accurate calibration service, contact your Kikusui agent.

4.2 Removing the Case

To remove the case, remove the five screws (Figure 4-1) and pull out the chassis forward.

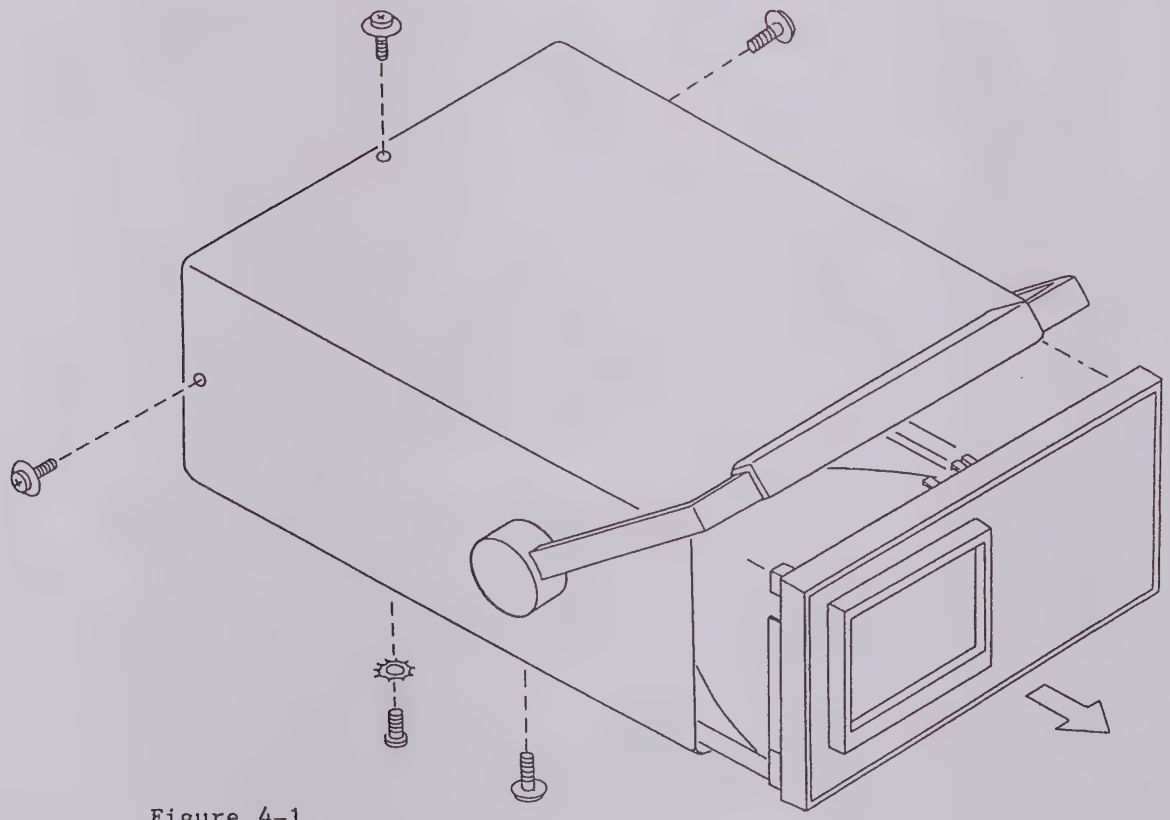


Figure 4-1

4.3 Check and Adjustment of DC Supply Voltages

Before calibrating the oscilloscope, its DC supply voltages should be checked and adjusted. Check and adjust the +12V supply voltage first and the other supply voltages next. The supply voltages are shown in the following table and the check and adjustment points are indicated in Figure 4-2.

Nominal voltage	Tolerance	Check and adjustment points
+5 V	+4.75 to +5.25 V	P-22 No. 7
+12 V	+11.95 to +12.05 V	P-22 No. 8, RV801
-12 V	-11.80 to -12.20 V	P-22 No. 9
+145 V	+140 to +150 V	P-22 No. 5
-1750 V	-1700 to -1800 V	P-19 No. 3

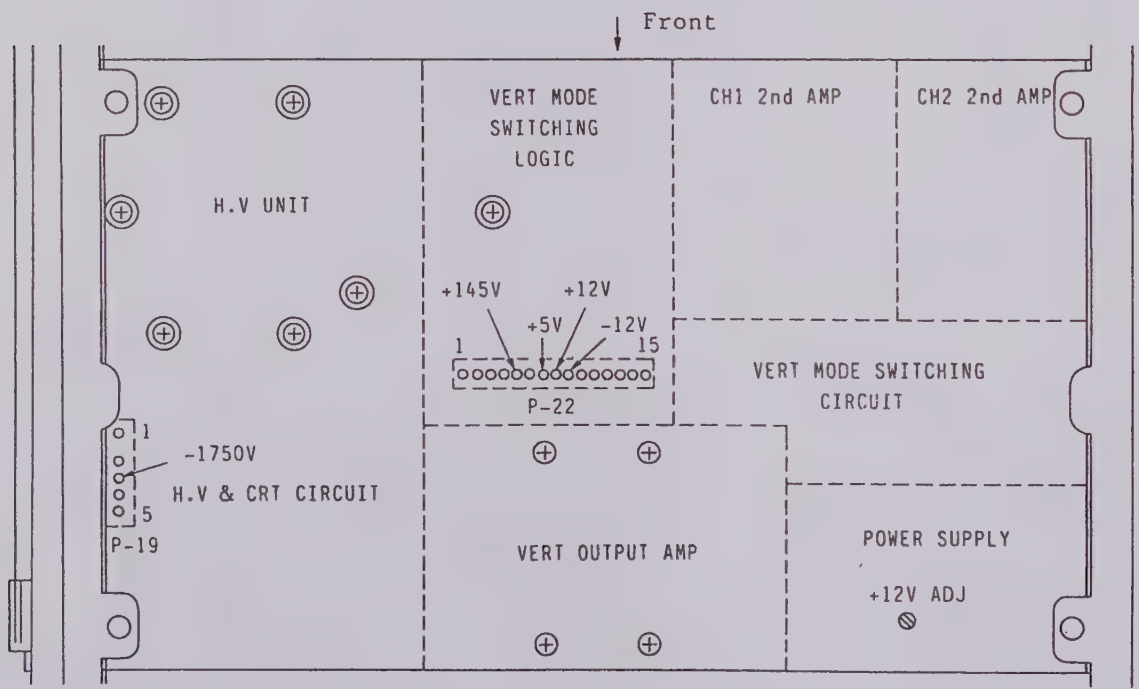


Figure 4-2 A2 printed circuit board

For voltage check, measure the voltage between check point and ground using precision digital voltmeter. The +12V supply must be especially carefully adjusted because it provides a reference for other supplies. To measure the -1750V supply of which internal impedance is high, use a voltmeter which has a sufficiently high input impedance (10 MΩ or over).

Because adjustments of supply voltages largely affect vertical sensitivity and horizontal sweep time, the oscilloscope must be re-calibrated as explained in the subsequent paragraphs.

4.4 Adjustment of CRT Circuits

Some adjustments of the CRT circuits directly affect the CRT deflection sensitivity as is the case of "Check and Adjustment of DC Supply Voltages" of the preceding section.

- o Adjustment of CRT BIAS:

This control is for adjusting the trace intensity and the operating position of the INTEN knob (2).

(1) Set the TIME/DIV switch (31) at 1 mS and display a single-line horizontal trace on the screen.

(2) Set the white mark of the INTEN knob at the 10 o'clock position and so adjust the CRT BIAS control (Figure 4-7, RV821) that the trace is displayed on the screen with a barely discernible intensity.

- o Adjustment of SUB-FOCUS:

This control is for adjusting the control range position of the FOCUS knob (4). With the FOCUS knob set with its white dot positioned upright (noon position), so adjust the SUB-FOCUS control (Figure 4-7, RV820) that the best focus is obtained.

o Adjustment of ASTIG:

This control is for focus adjustment of the electron lens of the CRT.

(1) Set the TIME/DIV switch (31) to the [X-Y | CH3 HOR] position and display the beam spot in the center of the CRT screen with the POSITION controls.

(2) Turn the FOCUS control (4) to an appropriate position and then adjust the ASTIG control (Figure 4-7, RV822) so that the shape of the displayed beam spot becomes as true circle as possible.

4.5 Adjustment of Vertical Axis

o Adjustment of STEP BAL:

This control is for minimizing the shift of trace when the VOLTS/DIV switch (10) or (13) is turned from the 5 mV position to the 10 mV position.

(1) Set the AC-GND-DC switch (7) or (16) and display the trace on the CRT screen.

(2) Turning the VOLTS/DIV switch between 5 mV and 10 mV positions, so adjust the STEP BAL control (Figure 4-8, RV101 or RV201) that the shift of trace becomes minimum.

o Adjustment of ×5 MAG BAL:

This control is for minimizing the shift of trace when the ×5 MAG switch (11) or (14) is changed.

(1) Set the AC-GND-DC switch (7) or (16) in the GND state and display a trace on the screen.

(2) Turning on and off the ×5 MAG switch, so adjust the ×5 MAG BAL control (Figure 4-8, RV104 or RV204) that the shift of trace becomes minimum.

o Adjustment of DC BAL:

This control is for minimizing the shift of the trace when the VARIABLE KNOB (11) or (14) is turned.

(1) Set the AC-GND-DC switch (7) or (16) in the GND state and display the trace on the CRT screen.

(2) Turning the VARIABLE knob, so adjust the DC BAL control that the shift of the trace becomes minimum. (Figure 4-8, RV106 and RV206).

o Sensitivity calibration of CH1 and CH2:

Calibrate the sensitivity of the vertical amplifier to the value indicated by the VOLTS/DIV switch (10) or (13). For this adjustment, use a square wave generator with an output voltage setting accuracy of 0.3% or better, at 1 kHz.

(1) Set the signal generator output at 80 mVp-p and apply the signal to the vertical input terminal (8) or (15).

(2) Set the VARIABLE knob (11) or (14) at the CAL'D position and set the VOLTS/DIV switch at the 10 mV range.

(3) So adjust the CH1 or CH2 GAIN control (Figure 4-7, RV108 or RV208) that the amplitude of the displayed waveform becomes 8 DIV.

By the above procedure, other ranges also are calibrated to an accuracy of ±3% or better.

o Sensitivity calibration of ×5 MAG:

In a similar manner as for sensitivity calibration of CH1 and CH2, calibrate the sensitivity for the ×5 MAG function.

(1) Set the signal generator output at 16 mVp-p and apply the signal to the vertical input terminals (8) and (15).

(2) Set the VARIABLE knob (11) or (14) at the CAL'D position, set the VOLTS/DIV switch (10) or (13) at the 10 mV range, and pull out the CH1 ×5 MAG switch (11) or (14).

(3) So adjust the CH1 or CH2 GAIN control (Figure 4-8, RV102 or RV202) that the amplitude of the displayed waveform becomes 8 DIV.

By the above procedure, other ranges also are calibrated to an accuracy of ±5% or better.

o Sensitivity calibration of CH3:

In a similar manner as for sensitivity calibration of CH1 and CH2, calibrate the sensitivity of the CH3 vertical amplifier.

(1) Set the signal generator output at 800 mVp-p and apply the signal to CH3 input terminal (20). Next, set the source selector switch (23) to the CH3 (EXT) position and display the waveform.

(2) So adjust the CH3 GAIN control (Figure 4-9, RV502) that the amplitude of the displayed waveform becomes 8 DIV.

o Adjustment of ADD BAL:

With both CH1 and CH2 channels operating in a single-line horizontal trace state at the center of the screen, so adjust this control that the traces do not shift even when the VERT MODE switch is changed to the ADD mode.

(1) Set the AC-GND-DC switches (7) and (16) in the GND state and display the traces of the two channels overlapped at the center of the screen.

(2) Change the VERT MODE switch to the ADD state and so adjust the ADD BAL control (Figure 4-7, RV401) that the traces are positioned at the center of the screen.

o Adjustment of square wave characteristics of vertical amplifiers:

This adjustment is to adjust the square wave characteristics of the vertical amplifiers and to make their frequency response flat. This adjustment should be done at a range which does not use the input attenuator (10 mV/DIV range), using a square wave of 100 kHz and that of 1 MHz.

Adjustment should be done using a quality square wave with a rise time of 1.0 nsec or faster, in the order of middle and high ranges, repeating adjustment for a few times.

(1) Adjustment for middle frequency range:

Set the VOLTS/DIV switch at 10 mV/DIV and the TIME/DIV switch at 20 μS/DIV. Apply to the vertical input terminal a square wave of 100 kHz and so adjust the signal generator output that the waveform is displayed with an amplitude of 6 DIV.

Next, so adjust RV411 (Figure 4-7) that the displayed waveform becomes as (b) in Figure 4-3.

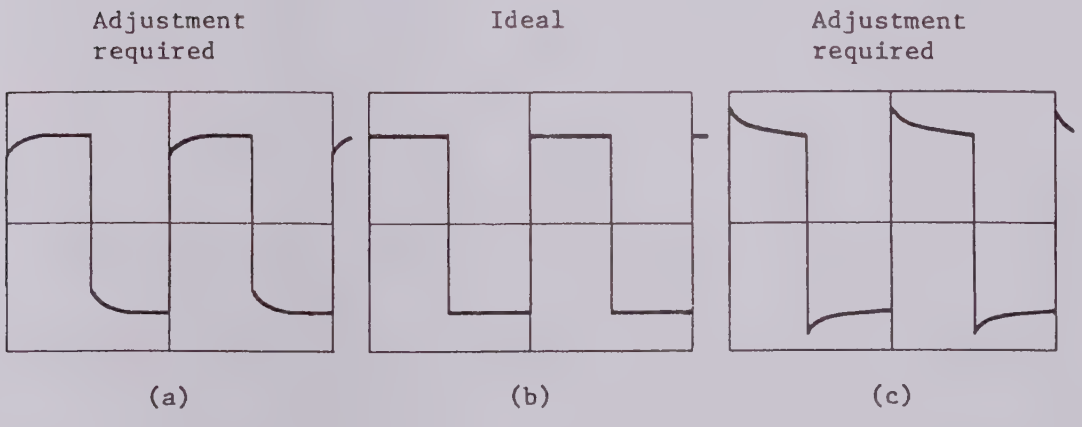


Figure 4-3

(2) Adjustment for high frequency range:

Change the input pulse signal frequency to 1 MHz and set the TIME/DIV switch at 0.2 S/DIV. Next, so adjust RV410 and C412 (Figure 4-7) that a waveform as shown in (b) of Figure 4-4 is obtained.

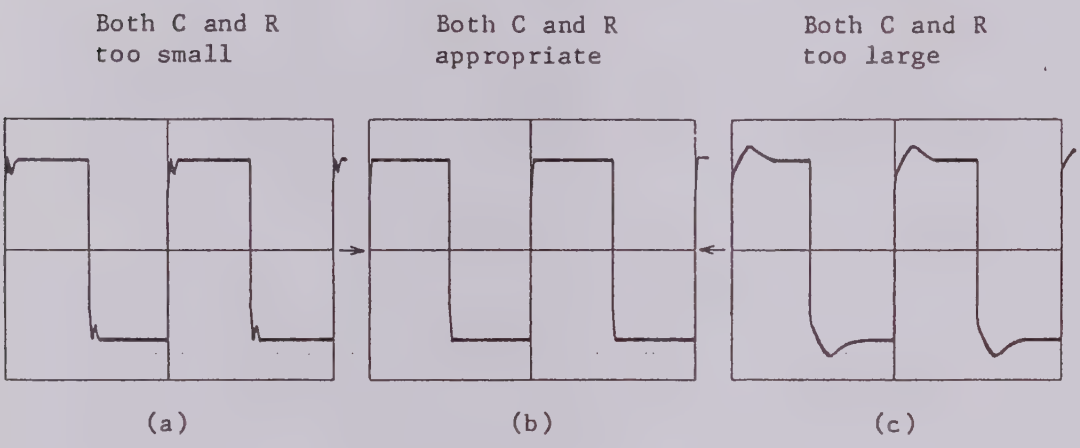


Figure 4-4

(3) Adjustment for highest frequency range:

This adjustment is to make still more sharp the leading edge and reduce ringing at the leading edge of the pulse waveform which has been adjusted in step (2).

For this adjustment, adjust at first CH1 and CH2 to the same characteristics and adjust CH3 next.

Change the TIME/DIV switch to the 50 nS/DIV position and expand the front edge of the pulse waveform which has been adjusted in step (2) "Adjustment for high frequency range." First, adjust RV107 and C144 (RV207 and C244 in the case of CH2) so that the front edge of the displayed waveform becomes flat. Next, adjust C132 of Figure 4-8 (C232 in the case of CH2) so that the leading edge becomes sharp.

Repeat the above adjustment so that flat square wave characteristics with sharp leading edge is obtained and the difference between CH1 and CH2 becomes minimum.

Next, change the channel to CH3 and adjust the HF COMPEN control (C519 of Figure 4-9).

After the above adjustment is done, check again that the frequency response characteristics of all channels are satisfactory.

o Adjustment of input ATT of CH1 and CH2:

The VOLTS/DIV switch selects the oscilloscope sensitivity by switching the attenuator circuit consisting of the 1st attenuator (1/1, 1/10, 1/100 steps) and the 2nd attenuator (1/1, 1/2, 1/4, 1/10 steps). This procedure is for phase compensation and input capacitance adjustment of the attenuators. Adjustments should be done in the order of phase compensation and input capacitance adjustment.

Use a square wave signal generator which provides a quality square wave of rise time 1 μsec or faster, without sags or overshoots. Apply the signal for each of the ranges (0.1 V, 1 V) and display a waveform with an amplitude of 6 DIV. So adjust the phase compensation capacitors shown in the following table (see Figure 4-4) that an ideal waveform is displayed. Next, connect a low-capacitance C-meter to the input terminal and so adjust the input-capacitance compensation capacitor that the input capacitance at each range becomes 25 pF ±2 pF.

Compensation capacitor / Range	CH1		CH2	
	Phase compensation	Input capacitor	Phase compensation	Input capacitor
0.1 V (1/10)	C103	C102	C203	C202
1 V (1/100)	C106	C105	C206	C205

o Adjustment of input ATT of CH3:

In a similar manner as is the case of "Adjustment of input ATT of CH1 and CH2," check that the 1/1 input capacitance is 25 pF ±2 pF. Next, adjust phase of the 1/10 attenuator with C512 (Figure 4-9) and input capacitance with C513.

o Adjustment of CH1 SIGNAL OUTPUT DC OFFSET:

* This adjustment must be made after "Adjustment of CH1 TRIG OFFSET" of Section 4.6 has been done.

This adjustment is to make zero the DC offset of the CH1 signal output with the DC OFFSET control.

(1) Apply the CH1 signal output to the CH2 input terminal using a coaxial cable.

(2) Display the CH2 input signal on the screen and set the VOLTS/DIV switch at the 10 mV range.

(3) Changing the CH2 input coupling switch between GND and DC, so adjust the CH1 SIGNAL OUTPUT DC OFFSET control RV112 (Figure 4-7) that shift of the trace becomes zero.

4.6 Adjustment of Trigger Circuit

o Adjustment of CH1 TRIG DC OFFSET:

This adjustment is for offsetting to zero the DC-component displacement of the CH1 internal trigger output.

(1) Apply a sinusoidal signal of approximately 1 kHz to the CH1 input terminal and set the AC-GND-DC switch at AC.

(2) Set the VERT MODE switch at CH1, set the INT TRIG switch at CH1 or ALT, and display the signal with an amplitude of 8 DIV on the screen.

(3) Set the COUPLING switch at AC and so adjust the LEVEL knob that the trigger point is brought to the center of the displayed waveform amplitude.

(4) Change the COUPLING switch to DC and so adjust the CH1 TRIG DC OFFSET (Figure 4-7, RV111) that the trigger point is brought to the center of the displayed waveform amplitude.

o Adjustment of CH2 TRIG DC OFFSET:

This adjustment is for offsetting to zero the DC-component displacement of the CH2 internal trigger output.

For this adjustment, adjust CH2 TRIG DC OFFSET (Figure 4-7, RV210) in a similar manner as is the case of "Adjustment of CH1 TRIG DC OFFSET."

4.7 Adjustment of Time Base

o Calibration of A sweep time:

This adjustment is for calibrating the sweep time to the values indicated by the TIME/DIV switch (31). For this adjustment, use time marker signals of accurate time intervals of 1 msec and 1 μsec or use signals of accurate frequencies of 1 kHz and 1 MHz.

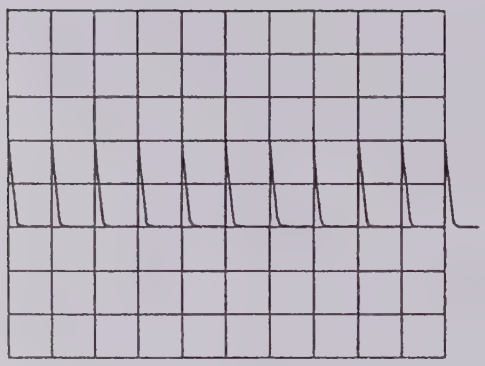
(1) Apply to the vertical input terminal a time marker signal of 1 msec or sinusoidal wave signal of 1 kHz and set the TIME/DIV switch (31) at 1 mS.

(2) So adjust the 1 mS CAL (Figure 4-9, RV601) that the displayed signal waveform conforms with scale divisions of the graticule.

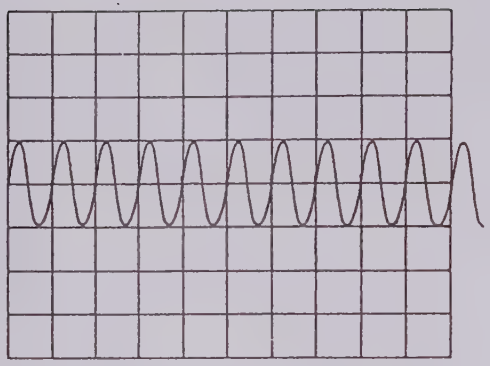
(3) Next, change the input signal to a 1-μsec time marker signal or a 1-MHz repetitive frequency signal and change the TIME/DIV switch (31) indication to 1 μS.

(4) So adjust C610 (Figure 4-9) that the displayed signal waveform conform with scale divisions of the graticule.

When the above calibration is complete, the sweep speeds of the remaining ranges of the TIME/DIV switch (31) also are calibrated to an accuracy of ±2% or better.



Time marker signal



Sinusoidal wave signal

Figure 4-5

o Calibration of B sweep time:

Calibrate the sweep time to the indicated values of the TIME/DIV switch (32). Adjust 1mS (Figure 4-9, RV606) and C617 (Figure 4-9) in a similar manner as that for the case of "Calibration of A sweep time."

o Adjustment of sweep start points:

This adjustment is for aligning the start points of the A and B sweeps.

(1) Set the TIME/DIV switches (31) and (32) at 1 mS, set the DISPLAY switch (30) at ALT, and display both A and B traces on the screen.

(2) So adjust the horizontal POSITION knob (36) that the start point of the A trace is brought to the left hand end of the graticule.

(3) Next, with the B SWEEP START POSITION control (Figure 4-9, RV608), bring the start point of the B trace to the left hand end of the graticule.

o Adjustment of ×10 MAG:

This adjustment is for calibration of the sweep time when the ×10 MAG switch (33) is turned on (pulled out). Before performing this adjustment, make sure that the adjustment for "Calibration of the A sweep time" has been done.

(1) Apply to the vertical input terminal a time marker signal of 0.1 mS or a signal of 10 kHz and display the signal with an appropriate amplitude on the screen.

(2) Set the VARIABLE knob (33) at the CAL'D position and the TIME/DIV switch (31) at 1 mS.

(3) Turn on (pull out) the ×10 MAG switch and so adjust the ×10 MAG GAIN ADJ (Figure 4-9, RV701) that the displayed waveform conforms with scale divisions of the graticule.

o Calibration of DELAY TIME MULT:

This calibration is for calibrating the dial value of the DELAY TIME MULT to the sweep time. Before performing this calibration, make sure that the adjustment for "Calibration for A sweep time" has been done.

(1) Apply to the vertical input terminal a time marker signal of 1 mS and display the waveform with an appropriate amplitude on the screen.

(2) Set the VARIABLE knob (33) at the CAL'D position, set the TIME/DIV switch (31) at 1 mS, set the TIME/DIV switch (32) at 10 μS, and change the DISPLAY switch (30) to the ALT state.

(3) Set the dial indication of the DELAY TIME MULT at 1.00 and align the displayed waveform with the graticule.

(4) So adjust the DT START (Figure 4-9, RV604) that the accentuated portion of the waveform is aligned to the initial pulse as shown in Figure 4-6.

(5) Set the dial indication of the DELAY TIME MULT at 10.00.

(6) So adjust the DT END (Figure 4-9, RV603) that the accentuated portion of the waveform is aligned to the 10th pulse.

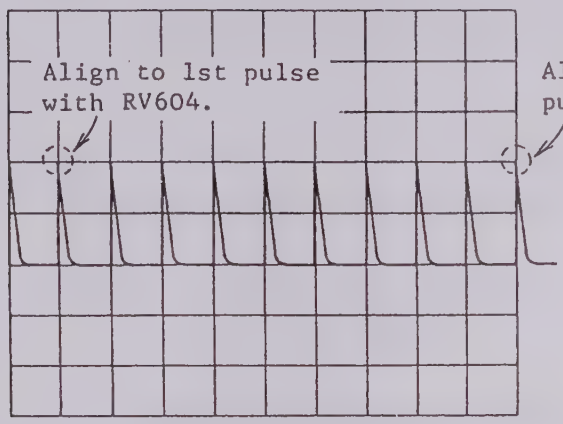


Figure 4-6

4.8 Adjustment of Horizontal Axis (X-axis)

o Calibration of horizontal sensitivity:

This adjustment is for calibration of the X-axis or CH3 HOR sensitivity for X-Y operation.

(1) Set at 1 Vp-p the output of the signal generator used for "Calibration of sensitivity" of Section 4.5, and apply the output to the CH3 input terminal.

(2) Set the TIME/DIV switch (31) at [X-Y | CH3 HOR], the SOURCE switch (23) at CH3, and the COUPLING switch (24) at DC.

(3) So adjust the CH3 HOR GAIN control (Figure 4-9, RV503) that the horizontal length of the trace becomes 10 DIV.

(4) Repeat the procedures of "Adjustment of CH1 SIGNAL OUTPUT DC OFFSET" of Section 4.5 and "Adjustment of CH1 TRIG DC OFFSET" of Section 4.6.

(5) Set the SOURCE switch (23) to the INT ([X-Y]) and the INT TRIG switch (18) to the [X-Y]. Set the signal generator output at 100 mV and apply it to the CH1 (X) input terminal.

(6) So adjust the X-GAIN control (Figure 4-7, RV110) that the horizontal length of the trace becomes 10 DIV.

o Adjustment of X-Y POSITION ADJ:

This adjustment is for adjusting the positional relationship for the ↔ POSITION control when operation is switched between the NORM sweep mode and the [X-Y | CH3 HOR] mode.

(1) Set the TIME/DIV switch (31) at 1 mS/DIV. Align the start point of the sweep with the left hand end of the CRT graticule with the ↔ POSITION control (36).

(2) Change the TIME/DIV switch (31) to the [X-Y | CH3 HOR] to select the X-Y mode.

(3) So adjust the X-Y POSITION ADJ control (Figure 4-9, RV504) that the beam spot is positioned at the center of the CRT graticule.

4.9 Adjustment of Calibration Signal

o Adjustment of repetition frequency:

This adjustment is for calibrating the repetition frequency of the calibration signal at 1 kHz.

(1) Connect the CAL output (40) to a frequency counter.

(2) So adjust the CAL ADJ (Figure 4-8, RV1601) that the frequency counter indicates 1 kHz.

LOWER PRINTED CIRCUIT BOARDS

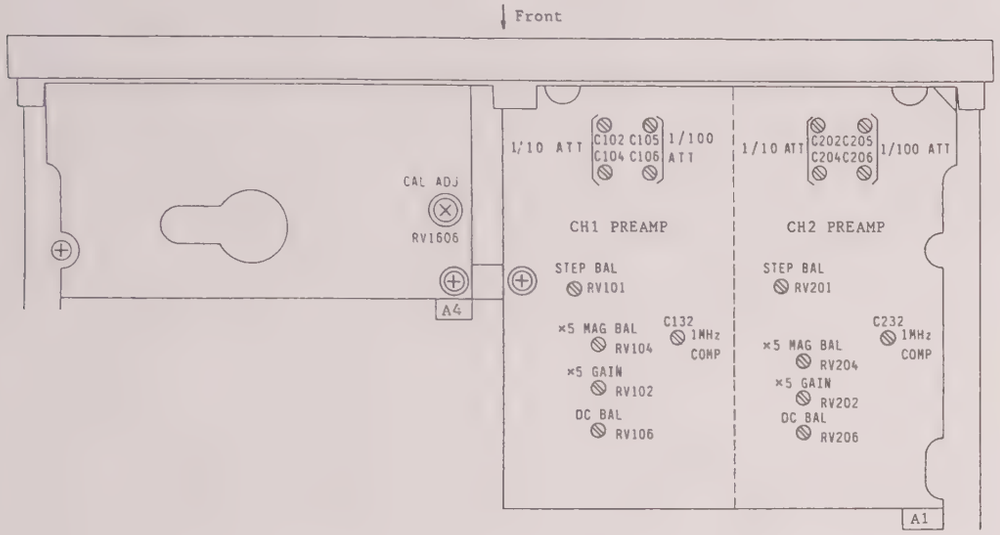


Figure 4-8

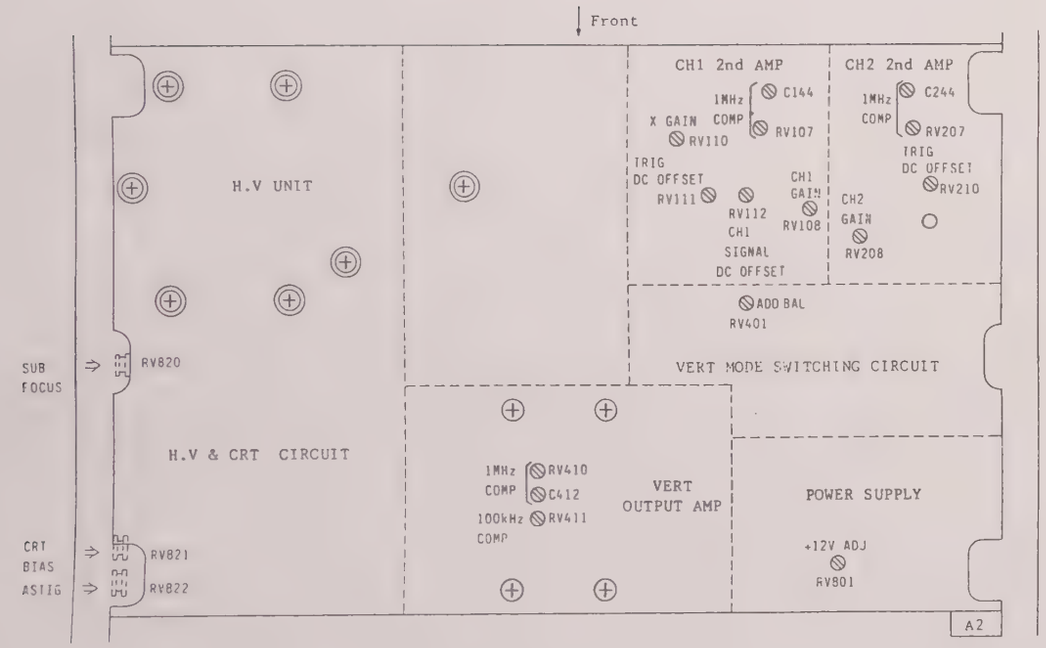
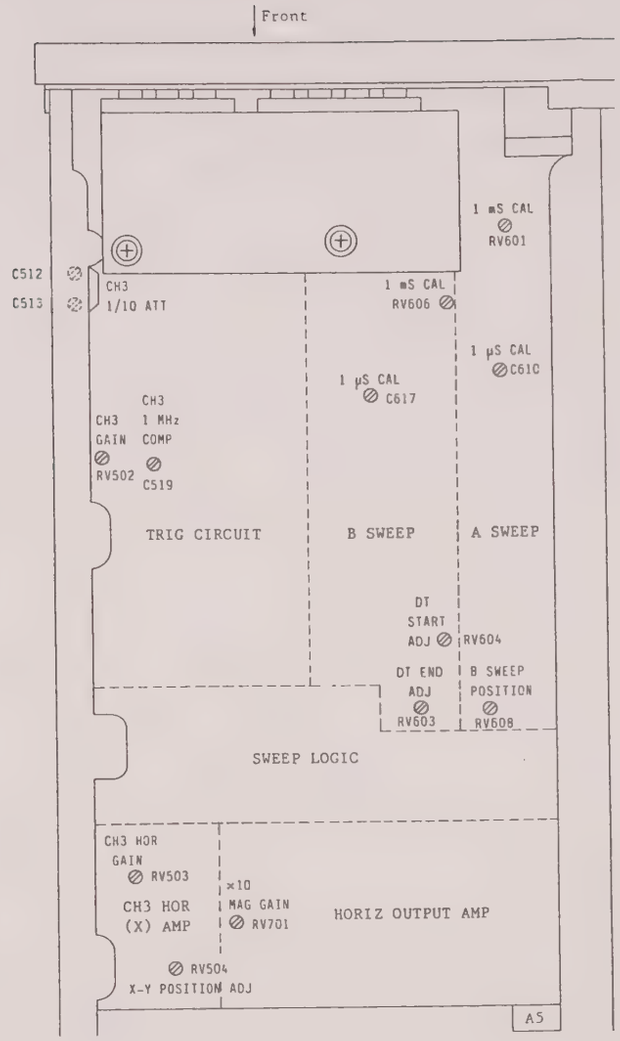
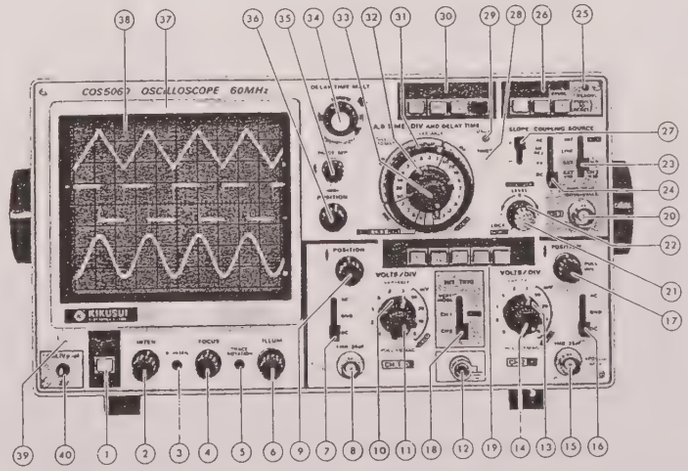


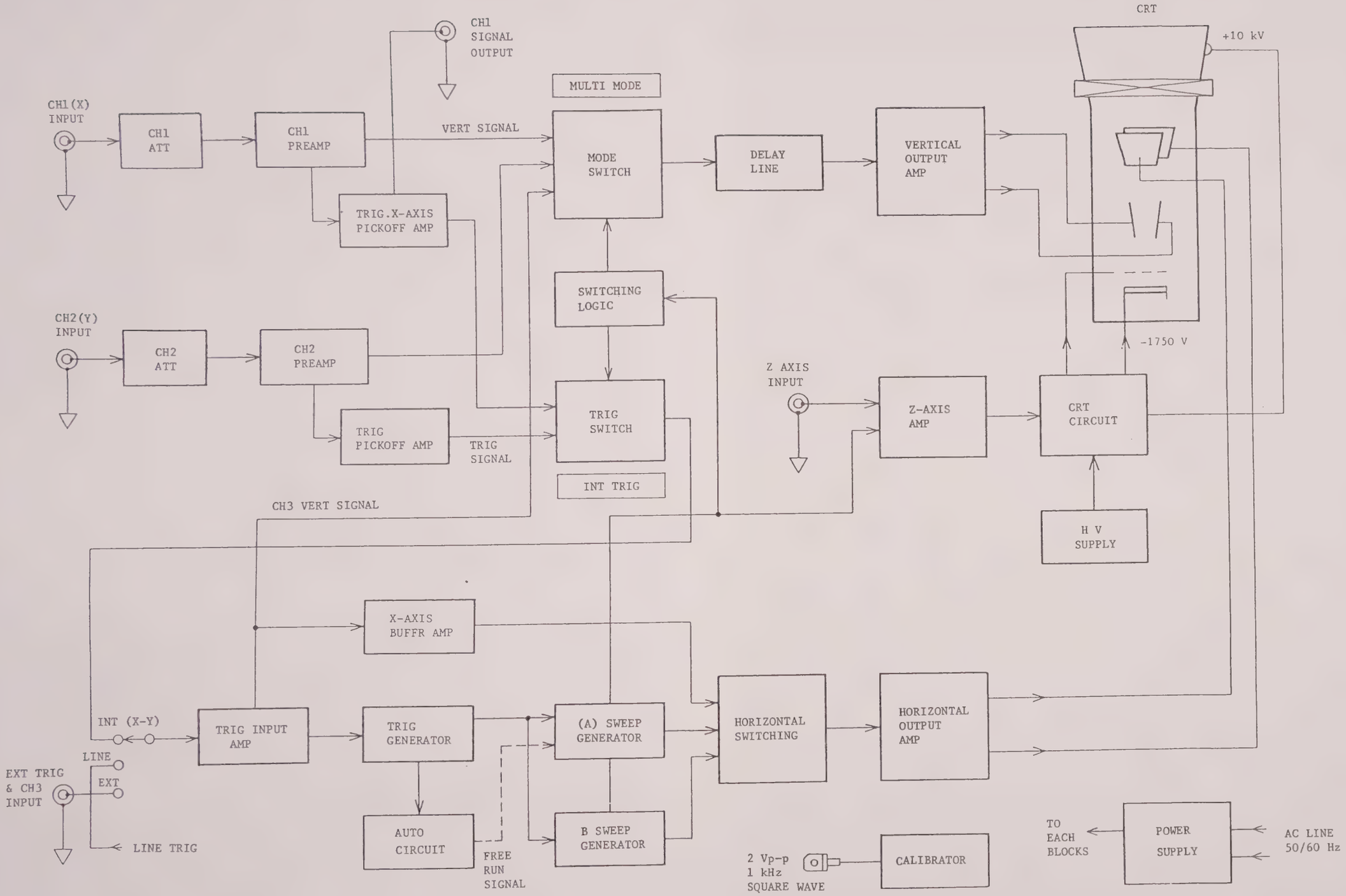
Figure 4-7



UPPER PRINTED CIRCUIT BOARD

Figure 4-9





BLOCK DIAGRAM

CIRCUIT SCHEMATICS

VERTICAL AMP & SWITCHING CIRCUIT ①

VERTICAL FINAL AMP & TRIGGER CIRCUIT ②

A, B SWEEP GENERATOR ③

POWER SUPPLY & CRT CIRCUIT ④

NOTES

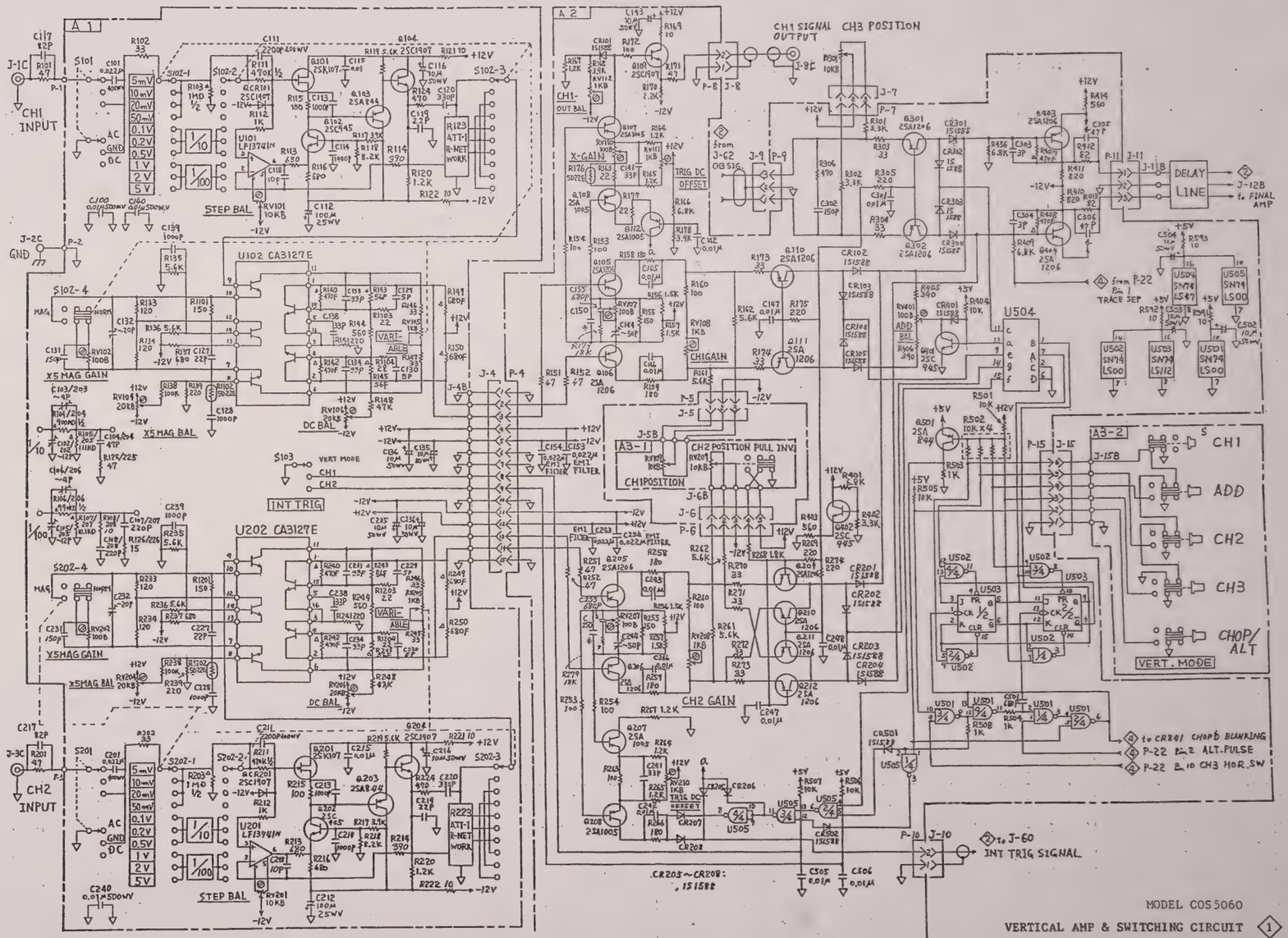
Diodes, transistors and ICs of type numbers different from those indicated but of equivalent characteristics may be used.
Unless otherwise indicated, resistance is given in ohms, 1/4W, 5%, carbon film and capacitor is given in farads.

* Optimum value selected at factory. Average value shown.

(Parts may be omitted.)

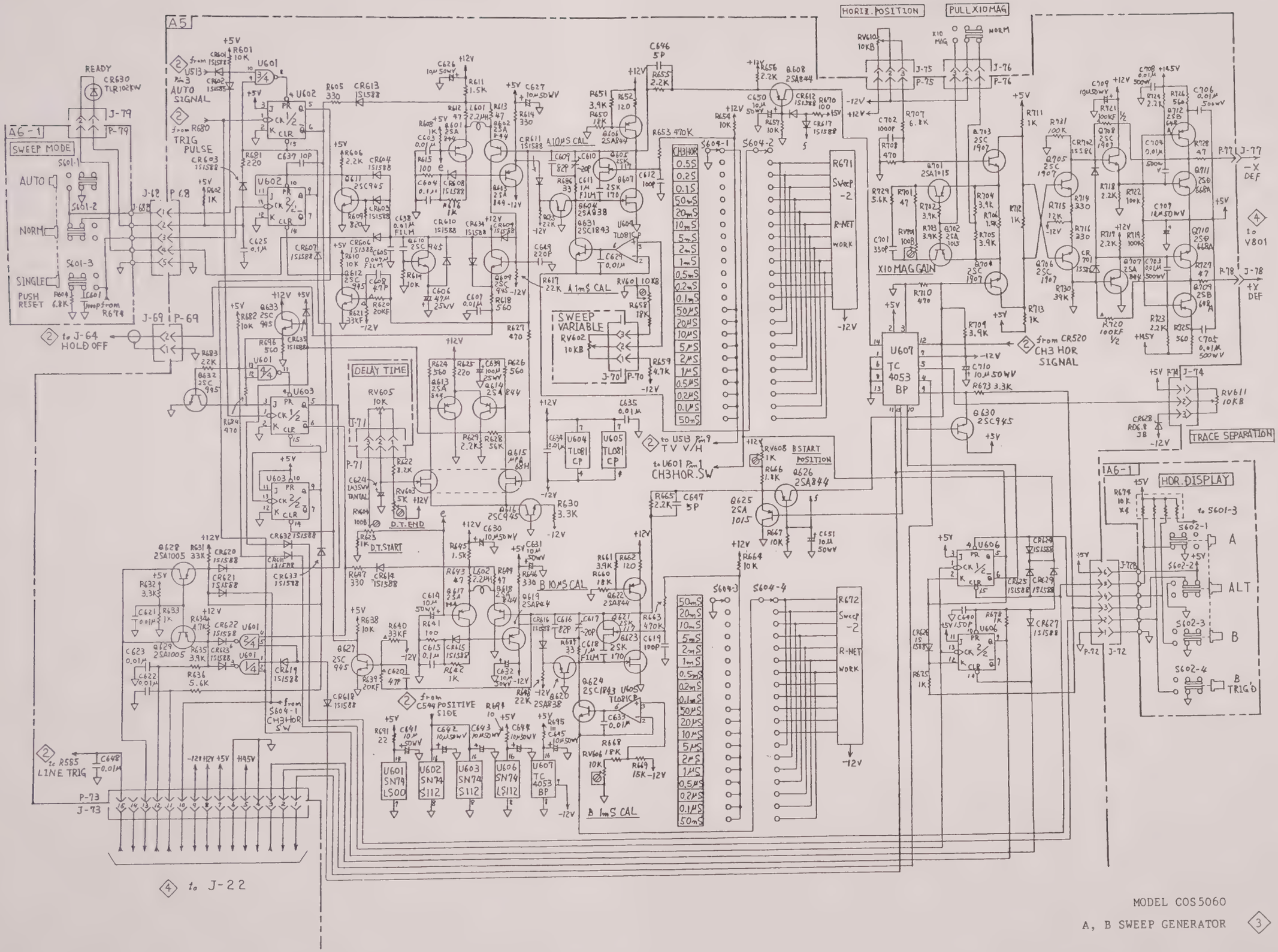
△ Metal film resistor.

⊘ Screwdriver adjustment.



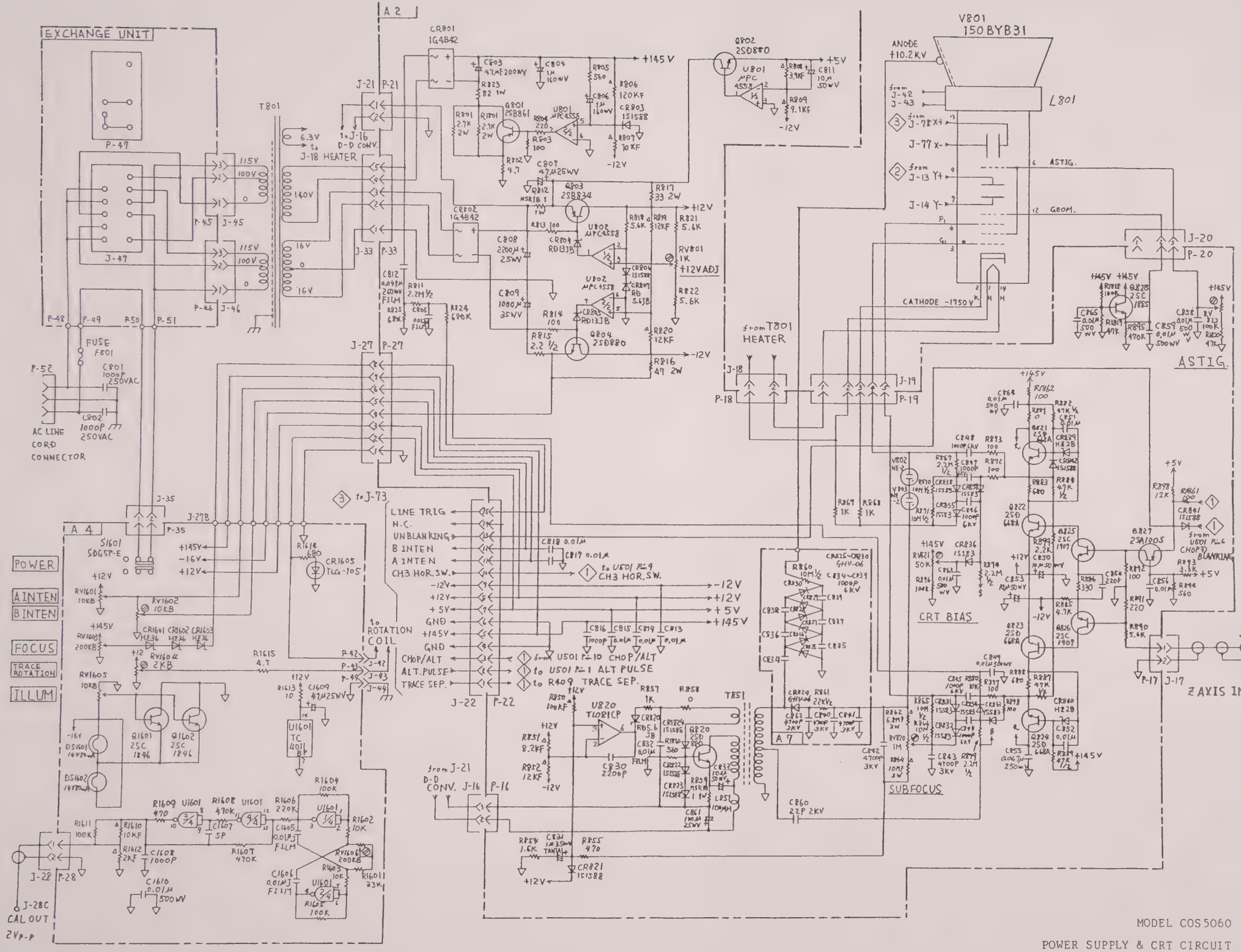
MODEL COS 5060

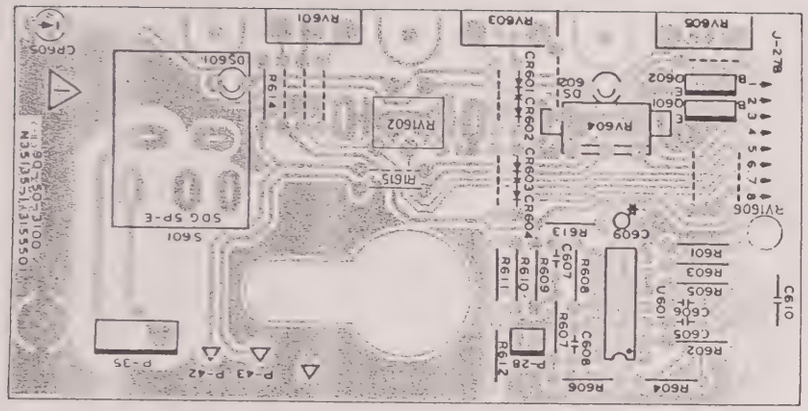
VERTICAL FINAL AMP & TRIGGER CIRCUIT ◇2



MODEL COS5060

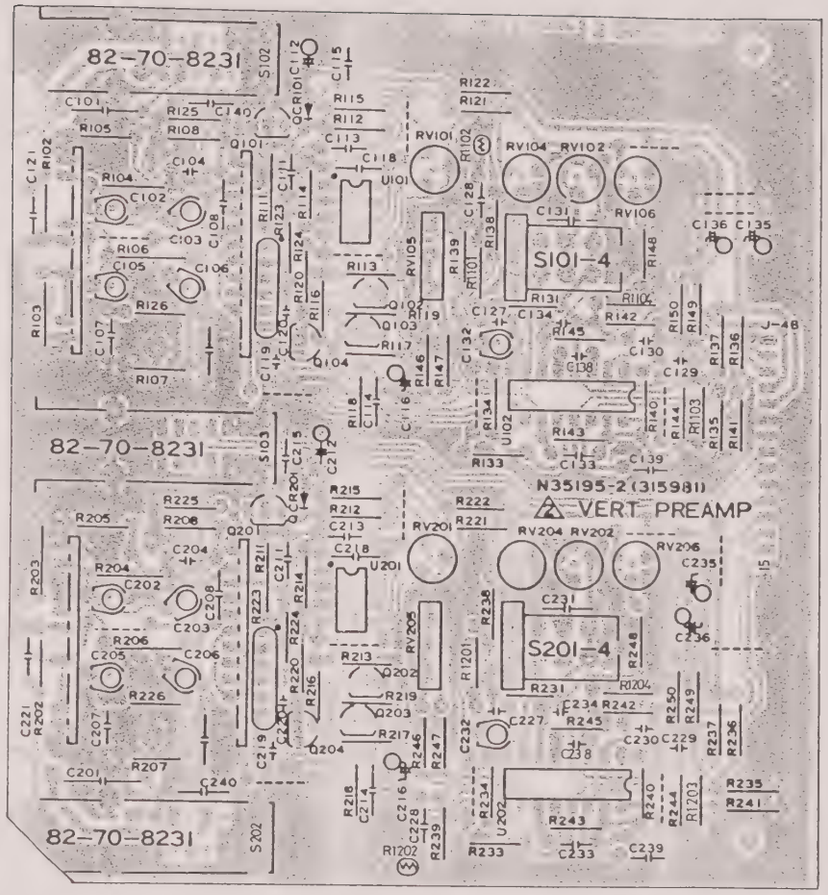
A, B SWEEP GENERATOR ◇3


EXCHANGE UNIT
A 2
T801
CR801 1G4B42
Q802 2SD880
V801 150BYB31
ANODE +10.2KV
L801
ASTIG.
GEOM.
CATHODE -1750V
J-20
P-20
ASTIG.
+145V
+12V
-12V
+5V
J-21
P-21
J-33
P-33
J-27
P-27
J-18 HEATER
6.3V
to J-16 D-D CONV.
140V
16V
115V
100V
J-45
J-46
J-47
P-45
P-46
P-47
P-48
P-49
P-50
P-51
FUSE F801
P-52
C801 1000P 250VAC
C802 1000P 250VAC
AC LINE CORD CONNECTOR
Q801 2SB861
Q803 2SB834
Q804 2SD880
U801 μPC4558
U802 μPC4558
CR802 1G4B42
CR804 RD13JB
CR805 RD 5.6JB
CR806 RD13JB
CR807 RD 5.6JB
CR803 1S1588
C807 47μ25WV
C808 2200μ 25WV
C809 1000μ 35WV
C812 0.047μ 250WV FILM
R801 2.7K 2W
R1701 2.7K 2W
R802 4.7
R803 100
R804 220
R805 560
R806 120KF
R807 30KF
R808 3.9KF
R809 9.1KF
R811 2.2M ½
R812 MSR1B 1
R813 100
R814 100
R815 2.2 ½
R817 33 2W
R818 5.6K
R819 12KF
R820 12KF
R821 5.6K
R822 5.6K
RV801 1K +12VADJ
R816 47 2W
C811 10μ 50WV
C803 47μF 200WV
C804 1μ 160WV
C806 1μ 160WV
R823 82 1W
J-35
J-27B
P-35
A 4
S1601 SDG5T-E
POWER
A INTEN
B INTEN
FOCUS
TRACE ROTATION
ILLUM
+145V
-16V
+12V
RV1601 10KB
RV1602 10KB
RV1603 200KB
RV1604 2KB
RV1605 10KB
CR1601 HZ36
CR1602 HZ36
CR1603 HZ36
R1615 4.7
R1613 10
C1609 47μ25WV
U1601 TC 401 BP
Q1601 2SC 1846
Q1602 2SC 1846
DS1601 14V82
DS1602 14V82
R1609 470
U1601 ¾
R1608 470K
R1606 220K
U1601 ¼
R1602 10K
R1611 100K
R1610 10KF
R1612 2KF
C1605 0.01μ FILM
C1607 5P
C1608 1000P
R1607 470K
R1604 100K
RV1606 200KB
R1603 10K
C1606 0.01μ FILM
U1601 ¾
R1605 100K
R1611 23K
C1610 0.01μ 500WV
J-28
P-28
J-28C CAL OUT 2Vp-p
R1618 680
CR1605 TLG-105
to ROTATION COIL
P-42
P-43
P-44
J-42
J-43
J-44
3 to J-73
LINE TRIG
N.C.
UNBLANKING
B INTEN
A INTEN
CH3 HOR.SW.
-12V
+12V
+5V
GND
+145V
GND
CHOP/ALT
ALT.PULSE
TRACE SEP.
J-22
P-22
C818 0.01μ
C817 0.01μ
1 to U501 P-9 CH3 HOR.SW.
C816 1000P
C815 0.01μ
C814 0.01μ
C813 0.01μ
1 from U501 P-10 CHOP/ALT
1 to U501 P-1 ALT PULSE
1 to R409 TRACE SEP.
from J-21 D-D CONV. J-16
P-16
U820 TL081CP
R850 100KF
R851 8.2KF
R852 12KF
C830 2200P
R857 1K
R858 0
TB51
Q820 2SD 880
CR820 RD5.6 JB
CR821 1S1588
CR822 1S1588
CR823 1S1588
CR824 1S1588
R859 MSR1B 1W
R860 560
C831 10μ 50WV
C832 0.01μ FILM
C833 10μ 50WV
CB1 100μH 25WV
LR51 100μH
R854 1.6K
R855 470
C821 1μ 35WV TANTAL
CR825-CR830 GHV-06
R860 10M ½
C834-C839 1000P 6KV
C860 22P 2KV
A 7
C862 4700P 3KV
C863 4700P 3KV
C840 4700P 3KV
C841 4700P 3KV
C842 4700P 3KV
R862 6.8M 2W
R870 1M
R864 10MF 3W
C843 4700P 3KV
R865 10M ½
R866 10M ½
R867 2.2M ½
C847 1000P 6KV
R870 100
R872 100
C848 1000P 6KV
R862 100
R871 0
R872 47K ½
C851 0.01μ
Q821 2SB 688A
CR829 HZ2B
CR842 1S1588
R883 680
R884 47K ½
Q822 2SD 668A
R893 2.2K
C850 10μ 50WV
Q825 2SC 1907
Q823 2SD 668A
R885 4.7K
Q826 2SC 1907
R887 47K ½
Q824 2SD 668A
CR840 HZ2B
C852 0.01μ
R889 +145V
C855 400μ 250WV
R878 12K
R861 100
CR841 1S1588
from U501 P-6 CHOP'D BLANKING
Q827 2SA1005
R893 3.3K
+5V
R892 100
C854 220P
C856 0.01μ
R894 560
R891 220
R890 5.6K
J-17
P-17
Z AXIS INPUT
C849 0.01μ 50WV
R888 680
R877 100
R878 100
R879 100
C853 10μ 50WV
R876 330
R874 2.2M ½
CRT BIAS
SUB FOCUS
C844 0.01μ 500 WV
R868 10K
R869 1K
R863 1K
V802 NE-2
V803 NE-2
R870 10M ½
R871 10M ½
C847 1000P 6KV
C846 1000P 6KV
C835 1000P 6KV
C836 1000P 6KV
C837 1000P 6KV
C838 1000P 6KV
C839 1000P 6KV
C834 1000P 6KV
C827 1000P 6KV
C828 1000P 6KV
C829 1000P 6KV
C830 1000P 6KV
C831 1000P 6KV
C832 1000P 6KV
C833 1000P 6KV
C834 1000P 6KV
C835 1000P 6KV
C836 1000P 6KV
C837 1000P 6KV
C838 1000P 6KV
C839 1000P 6KV
C840 1000P 6KV
C841 1000P 6KV
C842 4700P 3KV
C843 4700P 3KV
R862 6.8M 2W
R870 1M
R864 10MF 3W
R865 10M ½
R866 10M ½
R867 2.2M ½
R874 2.2M ½
R879 2.2M ½
C855 400μ 250WV



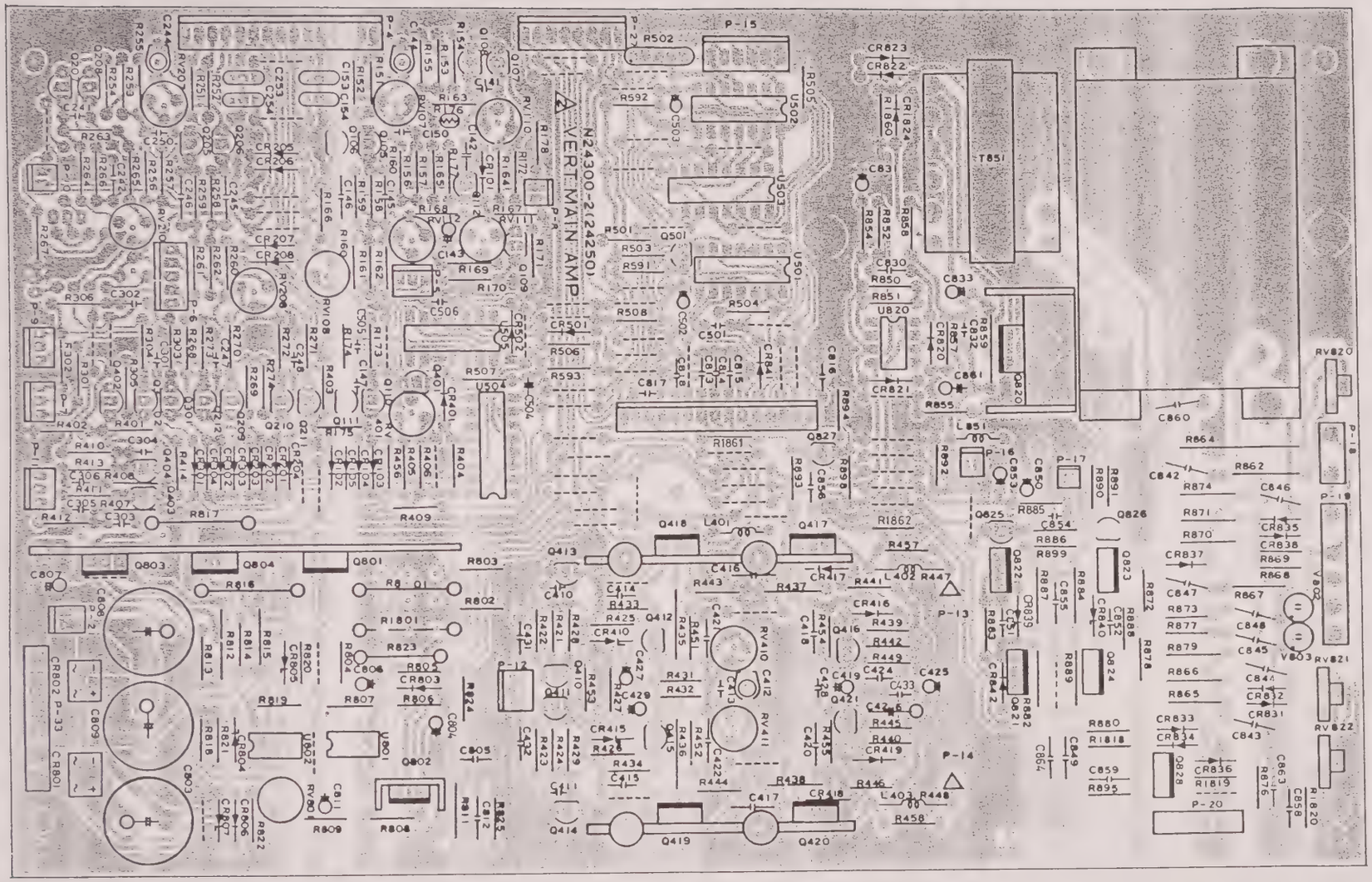
Cal & CRT Control A4 Parts Location Diagram

(Parts Side Veiw)



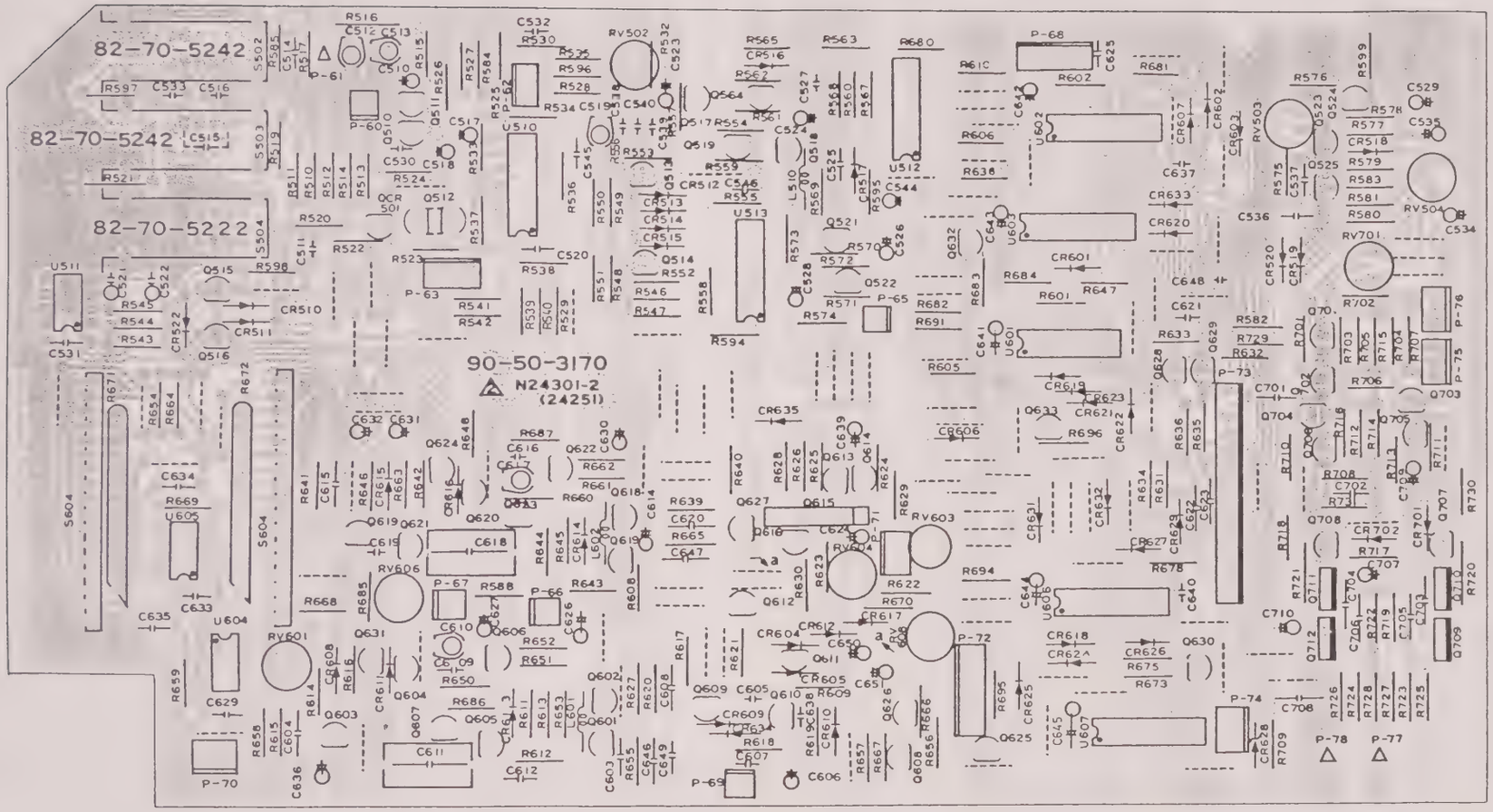
Vert Preamp Al Parts Location Diagram

(Parts Side Veiw)



(Parts Side Veiw)

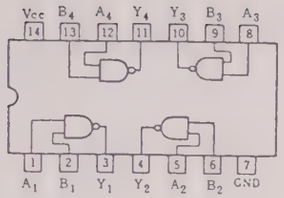
Vert Main Amp A2 Parts Location Diagram



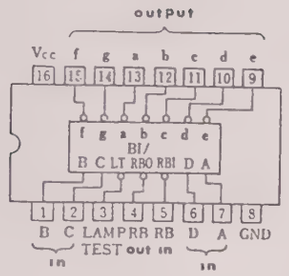
(parts Side Veiw)

Sweep & Horiz Amp A5 Parts Location Diagram

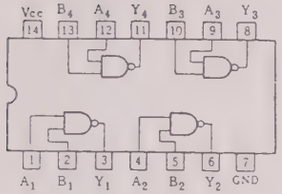
DIGITAL & ANALOG ICs



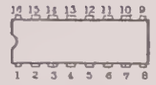
(TOP VIEW)
TC4011BP



(TOP VIEW)
SN74LS47N



(TOP VIEW)
SN74LS00N
74F00PC



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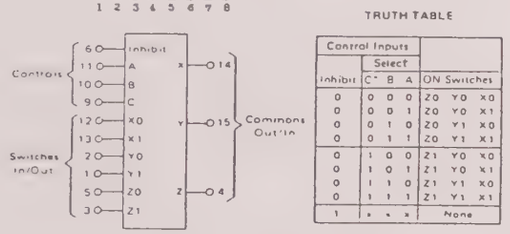
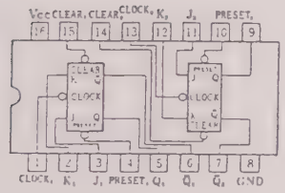
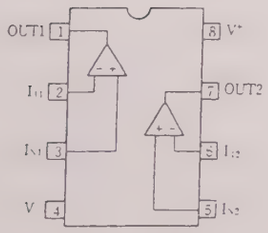

Inhibit
Controls
6 11 10 9
A B C
Switches In/Out
12 13 2 1 5 3
X0 X1 Y0 Y1 Z0 Z1
X Y Z
14 15 4
Common Out/In
TRUTH TABLE
Control Inputs
Select
Inhibit C B A ON Switches
0 0 0 0 Z0 Y0 X0
0 0 0 1 Z0 Y0 X1
0 0 1 0 Z0 Y1 X0
0 0 1 1 Z0 Y1 X1
0 1 0 0 Z1 Y0 X0
0 1 0 1 Z1 Y0 X1
0 1 1 0 Z1 Y1 X0
0 1 1 1 Z1 Y1 X1
1 * * * None

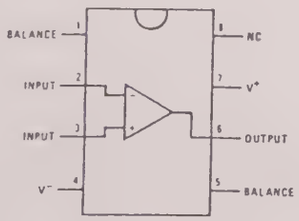
TC4053BP



(TOP VIEW)
SN74S112N
SN74LS112N



(TOP VIEW)
μPC4558C



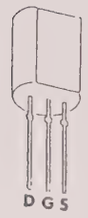
(TOP VIEW)
LF13741N
TL081CP

LED

TLG-105

TLG102KW
TLR102KW

FET



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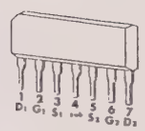
2SK117-BL
2SK170-V

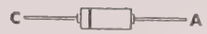
2SK228



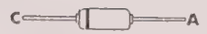
μPA68H

DIODE

GHV-06SSN



1S1588



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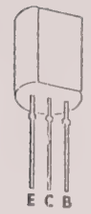
1SS86 RD6.8JB
HZ2B RD13JB
HZ36

1G4B42

TRANSISTOR



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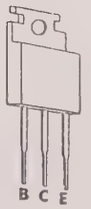
2SC1907

2SC2570

2SA1144-O
2SB648A
2SC1846
2SD668A

2SA1206-L



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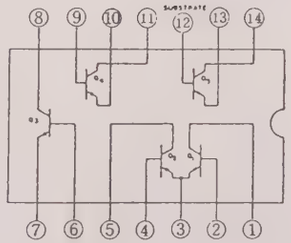
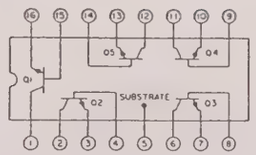
2SB861-C
2SD880-Y

2SA838-B
2SA1005-L
2SA1015-Y
2SC945-Q
2SC1843-E
2SC1885-R

TRANSISTOR ARRAY



(TOP VIEW)
CA3086



(TOP VIEW)
CA3127E

SEMICONDUCTOR LEAD CONFIGURATION

REPLACEABLE PARTS

ABBREVIATIONS

CER:	CERAMIC
C FILM:	CARBON FILM
C COMP:	CARBON COMPOSITION
CRT:	CATHODE RAY TUBE
ELECT:	ELECTROLYTIC
FET:	FIELD EFFECT TRANSISTOR
FXD:	FIXED
LED:	LIGHT EMITTING DIODE
M FILM:	METAL FILM
M GLAZE:	METAL GLAZE
M OX:	METAL OXIDE
M PLSTC FILM:	METALLIZED PLASTIC FILM
PLSTC FILM:	PLASTIC FILM
Si:	SILICON
TANT ELECT:	TANTALUM ELECTROLYTIC
VAR:	VARIABLE
WW:	WIREWOUND
*:	OPTIMUM VALUE SELECTED AT FACTORY. AVERAGE VALUE SHOWN. (PART MAY BE OMITTED.)

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION	
A1	ASSEMBLY		
Q101	31-20-1073	FET	SONY 2SK107-3
Q102	30-30-9451	TR SI NPN	NEC 2SC945-Q
Q103	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q104	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q201	31-20-1073	FET	SONY 2SK107-3
Q202	30-30-9451	TR SI NPN	NEC 2SC945-Q
Q203	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q204	30-31-9071	TR SI NPN	HITACHI 2SC1907
QCR101	30-31-9071	TR SI NPN	HITACHI 2SC1907
QCR201	30-31-9071	TR SI NPN	HITACHI 2SC1907
U101	34-00-0121	FET OPEAMP	N.S LF13741N
U102	30-90-0150	TRANSISTOR ARRAYS 5 NPN	RCA CA3127E
U201	34-00-0121	FET OPEAMP	N.S LF13741N
U202	30-90-0150	TRANSISTOR ARRAYS 5 NPN	RCA CA3127E
R102	40-27-0332	FXD C FILM 33 OHM 5% 1/4W	
R103	42-73-5100	FXD M FILM 1M OHM 0.5% 1/2W 100PPM/DEG	
R104	42-73-4900	FXD M FILM 900K OHM 0.5% 1/2W	
R105	42-71-4111	FXD M FILM 111K OHM 0.5% 1/4W	
R106	42-73-4990	FXD M FILM 990K OHM 0.5% 1/2W	
R107	42-71-3101	FXD M FILM 10.1K OHM 0.5% 1/4W	
R108	40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R111	40-37-4471	FXD C FILM 470K OHM 5% 1/2W	
R112	40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R113	40-27-1682	FXD C FILM 680 OHM 5% 1/4W	
R114	40-27-1392	FXD C FILM 390 OHM 5% 1/4W	
R115	40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R116	40-27-1682	FXD C FILM 680 OHM 5% 1/4W	
R117	40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W	
R118	40-27-2822	FXD C FILM 8.2K OHM 5% 1/4W	
R119	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R120	40-27-2122	FXD C FILM 1.2K OHM 5% 1/4W	
R121	40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R122	40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R123	44-04-0000	FXD M GLAZE R-NETWORK	KIKUSUI S8109001
R124	40-27-1472	FXD C FILM 470 OHM 5% 1/4W	
R125	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R126	40-27-0152	FXD C FILM 15 OHM 5% 1/4W	
R131	40-27-0000	JUMPER PARTS	
R133	40-27-1122	FXD C FILM 120 OHM 5% 1/4W	
R134	40-27-1122	FXD C FILM 120 OHM 5% 1/4W	
R135	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R136	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R137	40-27-1682	FXD C FILM 680 OHM 5% 1/4W	
R138	40-27-4102	FXD C FILM 100K OHM 5% 1/4W	
R139	40-27-1222	FXD C FILM 220 OHM 5% 1/4W	
R140	42-72-1470	FXD M FILM 470 OHM 1% 1/4W	
R141	40-27-1222	FXD C FILM 220 OHM 5% 1/4W	
R142	42-72-1470	FXD M FILM 470 OHM 1% 1/4W	
R143	42-72-0560	FXD M FILM 56 OHM 1% 1/4W	
R144	40-27-1562	FXD C FILM 560 OHM 5% 1/4W	
R145	42-72-0560	FXD M FILM 56 OHM 1% 1/4W	
R146	40-27-0332	FXD C FILM 33 OHM 5% 1/4W	
R147	40-27-0332	FXD C FILM 33 OHM 5% 1/4W	
R148	40-27-3472	FXD C FILM 47K OHM 5% 1/4W	
R149	42-72-1680	FXD M FILM 680 OHM 1% 1/4W	
R150	42-72-1680	FXD M FILM 680 OHM 1% 1/4W	
R202	40-27-0332	FXD C FILM 33 OHM 5% 1/4W	
R203	42-73-5100	FXD M FILM 1M OHM 0.5% 1/2W 100PPM/DEG	
R204	42-73-4900	FXD M FILM 900K OHM 0.5% 1/2W	
R205	42-71-4111	FXD M FILM 111K OHM 0.5% 1/4W	
R206	42-73-4990	FXD M FILM 990K OHM 0.5% 1/2W	
R207	42-71-3101	FXD M FILM 10.1K OHM 0.5% 1/4W	
R208	40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R211	40-37-4471	FXD C FILM 470K OHM 5% 1/2W	
R212	40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R213	40-27-1682	FXD C FILM 680 OHM 5% 1/4W	
R214	40-27-1392	FXD C FILM 390 OHM 5% 1/4W	
R215	40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R216	40-27-1682	FXD C FILM 680 OHM 5% 1/4W	
R217	40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W	
R218	40-27-2822	FXD C FILM 8.2K OHM 5% 1/4W	
R219	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R220	40-27-2122	FXD C FILM 1.2K OHM 5% 1/4W	

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION	
R221	40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R222	40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R223	44-04-0000	FXD M GLAZE R-NETWORK	KIKUSUI S8109001
R224	40-27-1472	FXD C FILM 470 OHM 5% 1/4W	
R225	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R226	40-27-0152	FXD C FILM 15 OHM 5% 1/4W	
R231	40-27-0000	JUMPER PARTS	
R233	40-27-1122	FXD C FILM 120 OHM 5% 1/4W	
R234	40-27-1122	FXD C FILM 120 OHM 5% 1/4W	
R235	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R236	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R237	40-27-1682	FXD C FILM 680 OHM 5% 1/4W	
R238	40-27-4102	FXD C FILM 100K OHM 5% 1/4W	
R239	40-27-1222	FXD C FILM 220 OHM 5% 1/4W	
R240	42-72-1470	FXD M FILM 470 OHM 1% 1/4W	
R241	40-27-1222	FXD C FILM 220 OHM 5% 1/4W	
R242	42-72-1470	FXD M FILM 470 OHM 1% 1/4W	
R243	42-72-0560	FXD M FILM 56 OHM 1% 1/4W	
R244	40-27-1562	FXD C FILM 560 OHM 5% 1/4W	
R245	42-72-0560	FXD M FILM 56 OHM 1% 1/4W	
R246	40-27-0332	FXD C FILM 33 OHM 5% 1/4W	
R247	40-27-0332	FXD C FILM 33 OHM 5% 1/4W	
R248	40-27-3472	FXD C FILM 47K OHM 5% 1/4W	
R249	42-72-1680	FXD M FILM 680 OHM 1% 1/4W	
R250	42-72-1680	FXD M FILM 680 OHM 1% 1/4W	
R1101	40-27-1152	FXD C FILM 150 OHM 5% 1/4W	
R1102	38-00-0000	THERMISTER 250 OHM	
R1103	40-27-0222	FXD C FILM 22 OHM 5% 1/4W	
R1104	40-27-0222	FXD C FILM 22 OHM 5% 1/4W	
R1201	40-27-1152	FXD C FILM 150 OHM 5% 1/4W	
R1202	38-00-0000	THERMISTER 250 OHM	
R1203	40-27-0222	FXD C FILM 22 OHM 5% 1/4W	
R1204	40-27-0222	FXD C FILM 22 OHM 5% 1/4W	
RV101	48-33-3100	VAR M FILM 10K OHM	
RV102	48-33-1100	VAR M FILM 100 OHM	
RV104	48-33-3200	VAR M FILM 20K OHM	
RV106	48-33-3200	VAR M FILM 20K OHM	
RV201	48-33-3100	VAR M FILM 10K OHM	
RV202	48-33-1100	VAR M FILM 100 OHM	
RV204	48-33-3200	VAR M FILM 20K OHM	
RV206	48-33-3200	VAR M FILM 20K OHM	
C100	52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2	
C101	50-96-3590	FXD PLSTC FILM 0.022UF 20% 630V	
C102	57-10-1191	VAR CER 3-10PF	
C103	57-10-1181	VAR CER 3-6PF	
C104	52-06-3185	FXD CER 47PF 10% 500V TYPE1	
C105	57-10-1191	VAR CER 3-10PF	
C106	57-10-1181	VAR CER 3-6PF	
C107	52-06-2265	FXD CER 220PF 10% 50V TYPE1	
C108	52-06-2265	FXD CER 220PF 10% 50V TYPE1	
C111	50-87-0510	FXD PLSTC FILM 2200PF 10% 400V	
C112	54-00-0121	FXD ELECT 100UF 25V	
C113	52-01-3345	FXD CER 1000PF 10% 500V TYPE2	
C114	52-01-3345	FXD CER 1000PF 10% 500V TYPE2	
C115	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2	
C116	54-00-0311	FXD ELECT 10UF 50V	
C118	52-06-3102	FXD CER 10PF 10% 500V TYPE1	
C119	52-06-3145	FXD CER 22PF 10% 500V TYPE1	
C120	52-01-2285	FXD CER 330PF 10% 50V TYPE2	
C121	52-06-3155	FXD CER 27PF 10% 500V TYPE1	
C127	52-06-3145	FXD CER 22PF 10% 500V TYPE1	
C128	52-01-3345	FXD CER 1000PF 10% 500V TYPE2	
C129	52-06-3051	FXD CER 5PF 10% 500V TYPE1	
C130	52-06-3051	FXD CER 5PF 10% 500V TYPE1	
C131	52-06-2265	FXD CER 220PF 10% 50V TYPE1	
C132	57-10-1203	VAR CER 5-20PF	
C133	52-06-3185	FXD CER 47PF 10% 500V TYPE1	
C134	52-06-3185	FXD CER 47PF 10% 500V TYPE1	
C135	54-00-0311	FXD ELECT 10UF 50V	
C136	54-00-0311	FXD ELECT 10UF 50V	
C138	52-06-3165	FXD CER 33PF 10% 500V TYPE1	
C139	52-01-3345	FXD CER 1000PF 10% 500V TYPE2	
C140	52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2	
C201	50-96-3590	FXD PLSTC FILM 0.022UF 20% 630V	
C202	57-10-1191	VAR CER 3-10PF	

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION	
C203	57-10-1181	VAR CER 3-6PF	
C204	52-06-3185	FXD CER 47PF 10% 500V TYPE1	
C205	57-10-1191	VAR CER 3-10PF	
C206	57-10-1181	VAR CER 3-6PF	
C207	52-06-2265	FXD CER 220PF 10% 50V TYPE1	
C208	52-06-2265	FXD CER 220PF 10% 50V TYPE1	
C211	50-87-0510	FXD PLSTC FILM 2200PF 10% 400V	
C212	54-00-0121	FXD ELECT 100UF 25V	
C213	52-01-3345	FXD CER 1000PF 10% 500V TYPE2	
C214	52-01-3345	FXD CER 1000PF 10% 500V TYPE2	
C215	52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2	
C216	54-00-0311	FXD ELECT 10UF 50V	
C218	52-06-3102	FXD CER 10PF 10% 500V TYPE1	
C219	52-06-3145	FXD CER 22PF 10% 500V TYPE1	
C220	52-01-2285	FXD CER 330PF 10% 50V TYPE2	
C221	52-06-3155	FXD CER 27PF 10% 500V TYPE1	
C227	52-06-3145	FXD CER 22PF 10% 500V TYPE1	
C228	52-01-3345	FXD CER 1000PF 10% 500V TYPE2	
C229	52-06-3051	FXD CER 5PF 10% 500V TYPE1	
C230	52-06-3051	FXD CER 5PF 10% 500V TYPE1	
C231	52-06-2265	FXD CER 220PF 10% 50V TYPE1	
C232	57-10-1203	VAR CER 5-20PF	
C233	52-06-3185	FXD CER 47PF 10% 500V TYPE1	
C234	52-06-3185	FXD CER 47PF 10% 500V TYPE1	
C235	54-00-0311	FXD ELECT 10UF 50V	
C236	54-00-0311	FXD ELECT 10UF 50V	
C238	52-06-3165	FXD CER 33PF 10% 500V TYPE1	
C239	52-01-3345	FXD CER 1000PF 10% 500V TYPE2	
C240	52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2	
S101	80-98-0580	SW ROTARY WITH RV VOLT/DIV	ALPS S21P2YC
S102	82-70-8231	LEVER SWITCH	ALPS SLR823-1
S103	82-70-8231	LEVER SWITCH	ALPS SLR823-1
S201	80-98-0580	SW ROTARY WITH RV VOLT/DIV	ALPS S21P2YC
S202	82-70-8231	LEVER SWITCH	ALPS SLR823-1
A2 ASSEMBLY			
CR101	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR102	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR103	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR104	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR105	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR201	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR202	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR203	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR204	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR205	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR206	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR207	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR208	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR301	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR302	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR303	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR304	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR401	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR410	32-92-0022	ZENER VZ=2.1-2.3V	HITACHI HZ2B-3
CR415	32-92-0022	ZENER VZ=2.1-2.3V	HITACHI HZ2B-3
CR416	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR417	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR418	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR419	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR501	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR502	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR801	32-90-2110	DIODE BRIDGE VRM=400V IO=1A	TOSHIBA 1G4B42
CR802	32-90-2110	DIODE BRIDGE VRM=400V IO=1A	TOSHIBA 1G4B42
CR803	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR804	32-92-0130	ZENER VZ=12.41-13.05V P=0.4W	NEC RD13J
CR805	32-92-0130	ZENER VZ=12.41-13.05V P=0.4W	NEC RD13J
CR806	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR807	32-92-0056	ZENER VZ=5.5-5.8V P=0.4W	NEC RD5.6J
CR820	32-92-0056	ZENER VZ=5.5-5.8V P=0.4W	NEC RD5.6J
CR821	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR822	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR823	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR831	32-30-0830	DIODE VR=250V IO=200MA	HITACHI 1SS83
CR832	32-30-0830	DIODE VR=250V IO=200MA	HITACHI 1SS83
CR833	32-30-0830	DIODE VR=250V IO=200MA	HITACHI 1SS83

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION	
CR834	32-30-0830	DIODE VR=250V IO=200MA	HITACHI 1SS83
CR835	32-30-0830	DIODE VR=250V IO=200MA	HITACHI 1SS83
CR836	32-30-0830	DIODE VR=250V IO=200MA	HITACHI 1SS83
CR837	32-30-0830	DIODE VR=250V IO=200MA	HITACHI 1SS83
CR838	32-30-0830	DIODE VR=250V IO=200MA	HITACHI 1SS83
CR839	32-92-0022	ZENER VZ=2.1-2.3V	HITACHI HZ2B-3
CR840	32-92-0022	ZENER VZ=2.1-2.3V	HITACHI HZ2B-3
CR841	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR842	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR1824	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
Q105	30-11-2061	TR SI PNP	NEC 2SA1206-L
Q106	30-11-2061	TR SI PNP	NEC 2SA1206-L
Q107	30-11-0051	TR SI PNP	NEC 2SA1005-L
Q108	30-11-0051	TR SI PNP	NEC 2SA1005-L
Q109	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q110	30-11-2061	TR SI PNP	NEC 2SA1206-L
Q111	30-11-2061	TR SI PNP	NEC 2SA1206-L
Q112	30-11-0051	TR SI PNP	NEC 2SA1005-L
Q205	30-11-2061	TR SI PNP	NEC 2SA1206-L
Q206	30-11-2061	TR SI PNP	NEC 2SA1206-L
Q207	30-11-0051	TR SI PNP	NEC 2SA1005-L
Q208	30-11-0051	TR SI PNP	NEC 2SA1005-L
Q209	30-11-2061	TR SI PNP	NEC 2SA1206-L
Q210	30-11-2061	TR SI PNP	NEC 2SA1206-L
Q211	30-11-2061	TR SI PNP	NEC 2SA1206-L
Q212	30-11-2061	TR SI PNP	NEC 2SA1206-L
Q301	30-11-2061	TR SI PNP	NEC 2SA1206-L
Q302	30-11-2061	TR SI PNP	NEC 2SA1206-L
Q401	30-30-9451	TR SI NPN	NEC 2SC945-Q
Q402	30-30-9451	TR SI NPN	NEC 2SC945-Q
Q403	30-11-2061	TR SI PNP	NEC 2SA1206-L
Q404	30-11-2061	TR SI PNP	NEC 2SA1206-L
Q410	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q411	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q412	30-32-5700	TR SI NPN	NEC 2SC2570
Q413	30-11-2061	TR SI PNP	NEC 2SA1206-L
Q414	30-11-2061	TR SI PNP	NEC 2SA1206-L
Q415	30-32-5700	TR SI NPN	NEC 2SC2570
Q416	30-32-5700	TR SI NPN	NEC 2SC2570
Q417	30-11-1441	TR SI PNP	TOSHIBA 2SA1144-O
Q418	30-40-6681	TR SI NPN	HITACHI 2SD668A-C
Q419	30-40-6681	TR SI NPN	HITACHI 2SD668A-C
Q420	30-11-1441	TR SI PNP	TOSHIBA 2SA1144-O
Q421	30-32-5700	TR SI NPN	NEC 2SC2570
Q501	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q801	30-20-8611	TR SI PNP	HITACHI 2SB861-C
Q802	30-40-8801	TR SI NPN	TOSHIBA 2SD880-Y
Q803	30-20-8341	TR SI PNP	TOSHIBA 2SB834-Y
Q804	30-40-8801	TR SI NPN	TOSHIBA 2SD880-Y
Q820	30-40-8801	TR SI NPN	TOSHIBA 2SD880-Y
Q821	30-40-6681	TR SI NPN	HITACHI 2SD668A-C
Q822	30-40-6681	TR SI NPN	HITACHI 2SD668A-C
Q823	30-40-6681	TR SI NPN	HITACHI 2SD668A-C
Q824	30-40-6681	TR SI NPN	HITACHI 2SD668A-C
Q825	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q826	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q827	30-11-0051	TR SI PNP	NEC 2SA1005-L
Q828	30-31-8851	TR SI NPN	MATSUSITA 2SC1885-R
U501	35-70-0001	QUAD 2-INPUT POSI-NAND	T.I SN74LS00N
U502	35-70-0001	QUAD 2-INPUT POSI-NAND	T.I SN74LS00N
U503	35-70-1121	DUAL J-K F-F	T.I SN74LS112N
U504	35-70-0471	BCD-TO-SEVEN-SEG DECO/DRI	T.I SN74LS47N
U505	35-70-0001	QUAD 2-INPUT POSI-NAND	T.I SN74LS00N
U801	34-00-0240	DUAL OPEAMP	NEC UPC4558C
U802	34-00-0240	DUAL OPEAMP	NEC UPC4558C
U820	34-00-0215	J-FET INPUT OPEAMP	N.S LF13741N
R151	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R152	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R153	40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R154	40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R155	40-27-1152	FXD C FILM 150 OHM 5% 1/4W	
R156	40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W	
R157	40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W	
R158	40-27-1182	FXD C FILM 180 OHM 5% 1/4W	

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION
R159	40-27-1182	FXD C FILM 180 OHM 5% 1/4W
R160	40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R161	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W
R162	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W
R163	40-27-0222	FXD C FILM 22 OHM 5% 1/4W
R164	40-27-2122	FXD C FILM 1.2K OHM 5% 1/4W
R165	40-27-2122	FXD C FILM 1.2K OHM 5% 1/4W
R166	40-27-2682	FXD C FILM 6.8K OHM 5% 1/4W
R167	40-27-2122	FXD C FILM 1.2K OHM 5% 1/4W
R168	40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W
R169	40-27-0102	FXD C FILM 10 OHM 5% 1/4W
R170	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W
R171	40-27-0472	FXD C FILM 47 OHM 5% 1/4W
R172	40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R173	40-27-0332	FXD C FILM 33 OHM 5% 1/4W
R174	40-27-0332	FXD C FILM 33 OHM 5% 1/4W
R175	40-27-1222	FXD C FILM 220 OHM 5% 1/4W
R176	38-00-0000	THERMISTER 250 OHM
R177	40-27-0222	FXD C FILM 22 OHM 5% 1/4W
R178	40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W
R179	40-27-3122	FXD C FILM 12K OHM 5% 1/4W
R251	40-27-0472	FXD C FILM 47 OHM 5% 1/4W
R252	40-27-0472	FXD C FILM 47 OHM 5% 1/4W
R253	40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R254	40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R255	40-27-1152	FXD C FILM 150 OHM 5% 1/4W
R256	40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W
R257	40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W
R258	40-27-1182	FXD C FILM 180 OHM 5% 1/4W
R259	40-27-1182	FXD C FILM 180 OHM 5% 1/4W
R260	40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R261	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W
R262	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W
R263	40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R264	40-27-2122	FXD C FILM 1.2K OHM 5% 1/4W
R265	40-27-2122	FXD C FILM 1.2K OHM 5% 1/4W
R266	40-27-1182	FXD C FILM 180 OHM 5% 1/4W
R267	40-27-2122	FXD C FILM 1.2K OHM 5% 1/4W
R268	40-27-2182	FXD C FILM 1.8K OHM 5% 1/4W
R269	40-27-1222	FXD C FILM 220 OHM 5% 1/4W
R270	40-27-0332	FXD C FILM 33 OHM 5% 1/4W
R271	40-27-0332	FXD C FILM 33 OHM 5% 1/4W
R272	40-27-0332	FXD C FILM 33 OHM 5% 1/4W
R273	40-27-0332	FXD C FILM 33 OHM 5% 1/4W
R274	40-27-1222	FXD C FILM 220 OHM 5% 1/4W
R279	40-27-3122	FXD C FILM 12K OHM 5% 1/4W
R301	40-27-2332	FXD C FILM 3.3K OHM 5% 1/4W
R302	40-27-2332	FXD C FILM 3.3K OHM 5% 1/4W
R303	40-27-0332	FXD C FILM 33 OHM 5% 1/4W
R304	40-27-0332	FXD C FILM 33 OHM 5% 1/4W
R305	40-27-1222	FXD C FILM 220 OHM 5% 1/4W
R306	40-27-1472	FXD C FILM 470 OHM 5% 1/4W
R401	40-27-2682	FXD C FILM 6.8K OHM 5% 1/4W
R402	40-27-2332	FXD C FILM 3.3K OHM 5% 1/4W
R403	40-27-1562	FXD C FILM 560 OHM 5% 1/4W
R404	40-27-3102	FXD C FILM 10K OHM 5% 1/4W
R405	40-27-1392	FXD C FILM 390 OHM 5% 1/4W
R406	40-27-1392	FXD C FILM 390 OHM 5% 1/4W
R407	42-72-1470	FXD M FILM 470 OHM 1% 1/4W
R408	42-72-1470	FXD M FILM 470 OHM 1% 1/4W
R409	40-27-2682	FXD C FILM 6.8K OHM 5% 1/4W
R410	40-27-1822	FXD C FILM 820 OHM 5% 1/4W
R411	40-27-1822	FXD C FILM 820 OHM 5% 1/4W
R412	40-27-0822	FXD C FILM 82 OHM 5% 1/4W
R413	40-27-0822	FXD C FILM 82 OHM 5% 1/4W
R414	40-27-1562	FXD C FILM 560 OHM 5% 1/4W
R421	42-72-1470	FXD M FILM 470 OHM 1% 1/4W
R422	42-72-0910	FXD M FILM 91 OHM 1% 1/4W
R423	42-72-0910	FXD M FILM 91 OHM 1% 1/4W
R424	42-72-1470	FXD M FILM 470 OHM 1% 1/4W
R425	40-27-1682	FXD C FILM 680 OHM 5% 1/4W
R426	40-27-1682	FXD C FILM 680 OHM 5% 1/4W
R427	40-27-1682	FXD C FILM 680 OHM 5% 1/4W
R428	40-27-1562	FXD C FILM 560 OHM 5% 1/4W
R429	40-27-1562	FXD C FILM 560 OHM 5% 1/4W
R431	40-27-1222	FXD C FILM 220 OHM 5% 1/4W
R432	40-27-1222	FXD C FILM 220 OHM 5% 1/4W

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION
R433	40-27-0222	FXD C FILM 22 OHM 5% 1/4W
R434	40-27-0222	FXD C FILM 22 OHM 5% 1/4W
R435	44-91-3220	FXD M OXIDE 22K OHM 5% 1W
R436	44-91-3220	FXD M OXIDE 22K OHM 5% 1W
R437	40-37-3391	FXD C FILM 39K OHM 5% 1/2W
R438	40-37-3391	FXD C FILM 39K OHM 5% 1/2W
R439	40-27-2332	FXD C FILM 3.3K OHM 5% 1/4W
R440	40-27-2332	FXD C FILM 3.3K OHM 5% 1/4W
R441	40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W
R442	40-27-8472	FXD C FILM 4.7 OHM 5% 1/4W
R443	40-27-8472	FXD C FILM 4.7 OHM 5% 1/4W
R444	40-27-8472	FXD C FILM 4.7 OHM 5% 1/4W
R445	40-27-8472	FXD C FILM 4.7 OHM 5% 1/4W
R446	40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W
R449	40-27-1152	FXD C FILM 150 OHM 5% 1/4W
R451	40-27-1332	FXD C FILM 330 OHM 5% 1/4W
R452	40-27-1332	FXD C FILM 330 OHM 5% 1/4W
R453	40-27-1682	FXD C FILM 680 OHM 5% 1/4W
R454	40-27-8472	FXD C FILM 4.7 OHM 5% 1/4W
R455	40-27-8472	FXD C FILM 4.7 OHM 5% 1/4W
R456	40-27-2682	FXD C FILM 6.8K OHM 5% 1/4W
R457	40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R458	40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R501	40-27-3102	FXD C FILM 10K OHM 5% 1/4W
R502	44-07-0020	FXD M GLAZE RESISTOR NETWORKS 10K OHM X4
R503	40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R504	40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R505	40-27-3102	FXD C FILM 10K OHM 5% 1/4W
R506	40-27-3102	FXD C FILM 10K OHM 5% 1/4W
R507	40-27-3102	FXD C FILM 10K OHM 5% 1/4W
R508	40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R591	40-27-0102	FXD C FILM 10 OHM 5% 1/4W
R592	40-27-0102	FXD C FILM 10 OHM 5% 1/4W
R593	40-27-0102	FXD C FILM 10 OHM 5% 1/4W
R801	44-92-2270	FXD M OXIDE 2.7K OHM 5% 2W
R802	40-27-8472	FXD C FILM 4.7 OHM 5% 1/4W
R803	40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R804	40-27-1222	FXD C FILM 220 OHM 5% 1/4W
R805	40-27-1562	FXD C FILM 560 OHM 5% 1/4W
R806	42-72-4120	FXD M FILM 120K OHM 1% 1/4W
R807	42-72-3100	FXD M FILM 10K OHM 1% 1/4W
R808	42-72-2390	FXD M FILM 3.9K OHM 1% 1/4W
R809	42-72-2910	FXD M FILM 9.1K OHM 1% 1/4W
R811	40-37-5221	FXD C FILM 2.2M OHM 5% 1/2W
R812	44-91-0010	FXD M OXIDE 1 OHM 5% 1W
R813	40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R814	40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R815	40-37-8222	FXD C FILM 2.2 OHM 5% 1/2W
R816	44-92-0470	FXD M OXIDE 47 OHM 5% 2W
R817	44-92-0330	FXD M OXIDE 33 OHM 5% 2W
R818	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W
R819	42-72-3120	FXD M FILM 12K OHM 1% 1/4W
R820	42-72-3120	FXD M FILM 12K OHM 1% 1/4W
R821	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W
R822	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W
R823	44-91-0820	FXD M OXIDE 82 OHM 5% 1W
R824	40-27-4681	FXD C FILM 680K OHM 5% 1/4W
R825	40-27-3682	FXD C FILM 68K OHM 5% 1/4W
R850	42-72-4100	FXD M FILM 100K OHM 1% 1/4W
R851	42-72-2820	FXD M FILM 8.2K OHM 1% 1/4W
R852	42-72-3120	FXD M FILM 12K OHM 1% 1/4W
R853	- -	
R854	40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W
R855	40-27-1472	FXD C FILM 470 OHM 5% 1/4W
R857	40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R858	40-27-0000	JUMPER PARTS
R859	44-91-0010	FXD M OXIDE 1 OHM 5% 1W
R862	42-34-2190	FXD M GLAZE 6.8M OHM 1% 0.8W
R864	42-44-0280	FXD M GLAZE 10M OHM 1% 1/6W
R865	40-37-6101	FXD C FILM 10M OHM 5% 1/2W
R866	40-37-6101	FXD C FILM 10M OHM 5% 1/2W
R867	40-37-5221	FXD C FILM 2.2M OHM 5% 1/2W
R868	40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R869	40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R870	40-37-6101	FXD C FILM 10M OHM 5% 1/2W
R871	40-37-6101	FXD C FILM 10M OHM 5% 1/2W
R872	40-27-1102	FXD C FILM 100 OHM 5% 1/4W

REFERENCE DESIGNATOR		KIKUSUI PARTS NO.	DESCRIPTION
R873		40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R874		40-37-5221	FXD C FILM 2.2M OHM 5% 1/2W
R875	*	— —	
R876		40-27-4102	FXD C FILM 100K OHM 5% 1/4W
R877		40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R878		40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R879		40-37-5221	FXD C FILM 2.2M OHM 5% 1/2W
R880		40-27-3102	FXD C FILM 10K OHM 5% 1/4W
R882		40-37-3471	FXD C FILM 47K OHM 5% 1/2W
R883		40-27-1682	FXD C FILM 680 OHM 5% 1/4W
R884		40-37-3471	FXD C FILM 47K OHM 5% 1/2W
R885		40-27-2472	FXD C FILM 4.7K OHM 5% 1/4W
R886		40-27-1332	FXD C FILM 330 OHM 5% 1/4W
R887		40-37-3471	FXD C FILM 47K OHM 5% 1/2W
R888		40-27-1682	FXD C FILM 680 OHM 5% 1/4W
R889		40-37-3471	FXD C FILM 47K OHM 5% 1/2W
R890		40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W
R891		40-27-1222	FXD C FILM 220 OHM 5% 1/4W
R892		40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R893		40-27-2332	FXD C FILM 3.3K OHM 5% 1/4W
R894		40-27-1562	FXD C FILM 560 OHM 5% 1/4W
R895		40-27-4472	FXD C FILM 470K OHM 5% 1/4W
R898		40-27-3122	FXD C FILM 12K OHM 5% 1/4W
R899		40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W
R1801		44-92-2270	FXD M OXIDE 2.7K OHM 5% 2W
R1818		40-27-4102	FXD C FILM 100K OHM 5% 1/4W
R1819		40-27-3472	FXD C FILM 47K OHM 5% 1/4W
R1820		40-27-3472	FXD C FILM 47K OHM 5% 1/4W
R1860		40-27-1562	FXD C FILM 560 OHM 5% 1/4W
R1861		40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R1862		40-27-1102	FXD C FILM 100 OHM 5% 1/4W
RV107		48-33-1100	VAR M FILM 100 OHM
RV108		48-33-2100	VAR M FILM 1K OHM
RV110		48-33-1100	VAR M FILM 100 OHM
RV111		48-33-2100	VAR M FILM 1K OHM
RV112		48-33-2100	VAR M FILM 1K OHM
RV207		48-33-1100	VAR M FILM 100 OHM
RV208		48-33-2100	VAR M FILM 1K OHM
RV210		48-33-2100	VAR M FILM 1K OHM
RV401		48-33-1100	VAR M FILM 100 OHM
RV410		48-33-2200	VAR M FILM 2K OHM
RV411		48-33-3200	VAR M FILM 20K OHM
RV801		48-33-2100	VAR M FILM 1K OHM
RV820		45-38-5100	VAR C COMP 1M OHM
RV821		45-38-4500	VAR C COMP 500K OHM
RV822		45-38-4100	VAR C COMP 100K OHM
C141		52-06-3165	FXD CER 33PF 10% 500V TYPE1
C142		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C143		54-00-0311	FXD ELECT 10UF 50V
C144		57-10-1223	VAR CER 8-50PF
C145		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C146		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C147		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C150		52-06-3102	FXD CER 10PF 10% 500V TYPE1
C153		56-48-1000	FXD CER EMI FILTER
C154		56-48-1000	FXD CER EMI FILTER
C155		52-01-3325	FXD CER 680PF 10% 500V TYPE2
C241		52-06-3165	FXD CER 33PF 10% 500V TYPE1
C242		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C244		57-10-1223	VAR CER 8-50PF
C245		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C246		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C247		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C248		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C250		52-06-3102	FXD CER 10PF 10% 500V TYPE1
C253		56-48-1000	FXD CER EMI FILTER
C254		56-48-1000	FXD CER EMI FILTER
C255		52-01-3325	FXD CER 680PF 10% 500V TYPE2
C301		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C302		52-06-2245	FXD CER 150PF 10% 50V TYPE1
C303		52-06-3030	FXD CER 3PF 10% 500V TYPE1
C304		52-06-3030	FXD CER 3PF 10% 500V TYPE1
C305		52-06-3185	FXD CER 47PF 10% 500V TYPE1
C306		52-06-3185	FXD CER 47PF 10% 500V TYPE1
C410		52-06-3155	FXD CER 27PF 10% 500V TYPE1

REFERENCE DESIGNATOR		KIKUSUI PARTS NO.	DESCRIPTION
C411		52-06-3155	FXD CER 27PF 10% 500V TYPE1
C412		57-10-1203	VAR CER 5-20PF
C413		52-06-3125	FXD CER 15PF 10% 500V TYPE1
C414		50-67-0030	FXD PLSTC FILM 0.01UF 10% 100V
C415		50-67-0030	FXD PLSTC FILM 0.01UF 10% 100V
C416		52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2
C417		52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2
C418		50-77-3500	FXD PLSTC FILM 0.047UF 20% 250V
C419		54-60-1550	FXD ELECT 1UF 160V
C420		50-77-3500	FXD PLSTC FILM 0.047UF 20% 250V
C421		52-96-1140	FXD COMP 0.47PF 10% 500V
C422		52-96-1140	FXD COMP 0.47PF 10% 500V
C424		50-67-0050	FXD PLSTC FILM 0.047UF 10% 100V
C425		54-60-1550	FXD ELECT 1UF 160V
C426		54-00-0301	FXD ELECT 1UF 50V
C427		54-00-0311	FXD ELECT 10UF 50V
C428		52-06-2265	FXD CER 220PF 10% 50V TYPE1
C429		54-00-0311	FXD ELECT 10UF 50V
C430		52-06-3145	FXD CER 22PF 10% 500V TYPE1
C431		52-06-3102	FXD CER 10PF 10% 500V TYPE1
C432		52-06-3102	FXD CER 10PF 10% 500V TYPE1
C433		52-06-3185	FXD CER 47PF 10% 500V TYPE1
C501		52-01-3325	FXD CER 680PF 10% 500V TYPE2
C502		54-00-0311	FXD ELECT 10UF 50V
C503		54-00-0311	FXD ELECT 10UF 50V
C504		54-00-0311	FXD ELECT 10UF 50V
C505		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C506		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C803		54-60-1620	FXD ELECT 47UF 200V
C804		54-60-1550	FXD ELECT 1UF 160V
C805		50-67-0040	FXD PLSTC FILM 0.022UF 10% 100V
C806		54-60-1550	FXD ELECT 1UF 160V
C807		54-00-0114	FXD ELECT 47UF 25V
C808		54-30-1650	FXD ELECT 2200UF 25V
C809		54-00-0231	FXD ELECT 1000UF 35V
C811		54-00-0311	FXD ELECT 10UF 50V
C812		50-77-3500	FXD PLSTC FILM 0.047UF 20% 250V
C813		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C814		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C815		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C816		52-01-3345	FXD CER 1000PF 10% 500V TYPE2
C817		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C818		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C830		52-01-3385	FXD CER 2220PF 10% 500V TYPE2
C831		55-37-2050	FXD TANT ELECT 1UF 35V
C832		50-67-0030	FXD PLSTC FILM 0.01UF 10% 100V
C833		54-00-0311	FXD ELECT 10UF 50V
C842		52-98-1000	FXD CER 4700PF +80-20% 3.15KV TYPE1
C843		52-98-1000	FXD CER 4700PF +80-20% 3.15KV TYPE1
C844		52-98-1010	FXD CER 1000PF +80-20% 6.3KV TYPE1
C845		52-98-1010	FXD CER 1000PF +80-20% 6.3KV TYPE1
C846		52-98-1010	FXD CER 1000PF +80-20% 6.3KV TYPE1
C847		52-98-1010	FXD CER 1000PF +80-20% 6.3KV TYPE1
C848		52-98-1010	FXD CER 1000PF +80-20% 6.3KV TYPE1
C849		52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2
C850		54-00-0311	FXD ELECT 10UF 50V
C851		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C852		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C853		54-00-0311	FXD ELECT 10UF 50V
C854		52-06-2265	FXD CER 220PF 10% 50V TYPE1
C855		50-77-3500	FXD PLSTC FILM 0.047UF 20% 250V
C856		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C858		52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2
C859		52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2
C860		52-08-5145	FXD CER 22PF 10% 2KV TYPE1
C861		54-00-0121	FXD ELECT 100UF 25V
C863	*	52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2
C864		52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2
C865		52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2
L401		67-10-0940	INDUCTOR 10UH 10%
L402		- -	INDUCTOR 0.26UH 10%
L403		- -	INDUCTOR 0.26UH 10%
L851		67-10-0890	INDUCTOR 100MH 10%
T851		63-92-0130	CONVERTOR TRANS KIKUSUI S810115
V802		23-70-0000	LAMP NEON

REFERENCE DESIGNATOR		KIKUSUI PARTS NO.	DESCRIPTION	
V803		23-70-0000	LAMP NEON	
A4 ASSEMBLY				
CR1601		32-92-0360	ZENER VZ=35.3-36.8V	HITACHI HZ36L-2
CR1602		32-92-0360	ZENER VZ=35.3-36.8V	HITACHI HZ36L-2
CR1603		32-92-0360	ZENER VZ=35.3-36.8V	HITACHI HZ36L-2
CR1605		37-00-0060	LAMP LED GREEN	TOSHIBA TLG-105
Q1601		30-31-8461	TR SI NPN	MATSUSHITA 2SC1846-R
Q1602		30-31-8461	TR SI NPN	MATSUSHITA 2SC1846-R
U1601		35-60-0000	QUAD 2-INPUT NAND GATES	TOSHIBA TC4011BP
R1601	*	40-27-3332	FXD C FILM 33K OHM 5% 1/4W	
R1602		40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R1603		40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R1604		40-27-4102	FXD C FILM 100K OHM 5% 1/4W	
R1605		40-27-4102	FXD C FILM 100K OHM 5% 1/4W	
R1606		40-27-4222	FXD C FILM 220K OHM 5% 1/4W	
R1607		40-27-4472	FXD C FILM 470K OHM 5% 1/4W	
R1608		40-27-4472	FXD C FILM 470K OHM 5% 1/4W	
R1609		40-27-1472	FXD C FILM 470 OHM 5% 1/4W	
R1610		42-72-3100	FXD M FILM 10K OHM 1% 1/4W	
R1611	*	40-27-4102	FXD C FILM 100K OHM 5% 1/4W	
R1612		42-72-2200	FXD M FILM 2K OHM 1% 1/4W	
R1613		40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R1614		40-27-1682	FXD C FILM 680 OHM 5% 1/4W	
R1615		40-27-8472	FXD C FILM 4.7 OHM 5% 1/4W	
RV1601		45-44-3100	VAR C COMP 10K OHM	
RV1602		45-43-3100	VAR M GLAZE 10K OHM	
RV1603		45-44-4200	VAR C COMP 200K OHM	
RV1604		45-43-2200	VAR M GLAZE 2K OHM	
RV1605		45-44-3100	VAR C COMP 10K OHM	
RV1606		48-33-4200	VAR M FILM 200K OHM	
C1605		50-45-0500	FXD PLSTC FILM 0.01MF 5% 50V	
C1606		50-45-0500	FXD PLSTC FILM 0.01MF 5% 50V	
C1607		52-06-3051	FXD CER 5PF 10% 500V TYPE1	
C1608		52-01-3345	FXD CER 1000PF 10% 500V TYPE2	
C1609		54-00-0114	FXD ELECT 47UF 25V	
C1610		52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2	
DS1601		23-44-0000	LAMP 14V 80MA	
DS1602		23-44-0000	LAMP 14V 80MA	
A5 ASSEMBLY				
CR510		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR511		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR512		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR513		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR514		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR515		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR516		32-30-0860	DIODE VR=30V IO=30MA	HITACHI 1SS86
CR517		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR518		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR519		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR520		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR522		32-92-0056	ZENER VZ=5.5-5.8V P=0.4W	NEC RD5.6J
CR601		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR602		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR603		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR604		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR605		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR606		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR607		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR608		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR609		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR610		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR611		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR612		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR613		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR614		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR615		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR616		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR617		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR618		32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION	
CR619	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR620	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR621	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR622	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR623	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR624	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR625	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR626	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR627	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR628	32-92-0068	ZENER VZ 6.4-7.2V P=0.4W	NEC RD6.8J
CR629	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR631	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR632	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR633	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR634	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR635	32-11-5880	DIODE VR=30V IO=120MA	TOSHIBA 1S1588
CR701	32-30-0860	DIODE VR=30V IO=30MA	HITACHI 1SS86
CR702	32-30-0860	DIODE VR=30V IO=30MA	HITACHI 1SS86
Q510	30-11-2061	TR SI PNP	NEC 2SA1206-L
Q511	30-11-2061	TR SI PNP	NEC 2SA1206-L
Q512	31-20-2281	FET DUAL	SONY 2SK228-1-3
Q513	30-11-0051	TR SI PNP	NEC 2SA1005-L
Q514	30-11-0051	TR SI PNP	NEC 2SA1005-L
Q515	30-10-8381	TR SI PNP	MATSUSHITA 2SA838-B
Q516	30-10-8381	TR SI PNP	MATSUSHITA 2SA838-B
Q517	31-20-1171	FET	TOSHIBA 2SK117-BL
Q518	30-11-0151	TR SI PNP	TOSHIBA 2SA1015-Y
Q519	30-10-8381	TR SI PNP	MATSUSHITA 2SA838-B
Q521	30-11-0051	TR SI PNP	NEC 2SA1005-L
Q522	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q523	30-30-9451	TR SI NPN	NEC 2SC945-Q
Q524	30-30-9451	TR SI NPN	NEC 2SC945-Q
Q525	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q564	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q601	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q602	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q603	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q604	30-10-8381	TR SI PNP	MATSUSHITA 2SA838-B
Q605	31-20-1171	FET	TOSHIBA 2SK117-BL
Q606	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q607	31-20-1701	FET	TOSHIBA 2SK 170-V
Q608	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q609	30-30-9451	TR SI NPN	NEC 2SC945-Q
Q610	30-30-9451	TR SI NPN	NEC 2SC945-Q
Q611	30-30-9451	TR SI NPN	NEC 2SC945-Q
Q612	30-30-9451	TR SI NPN	NEC 2SC945-Q
Q613	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q614	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q615	31-90-0080	DUAL FET	NEC UPA68H-M
Q616	30-30-9451	TR SI NPN	NEC 2SC945-Q
Q617	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q618	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q619	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q620	30-10-8381	TR SI PNP	MATSUSHITA 2SA838-B
Q621	31-20-1171	FET	TOSHIBA 2SK117-BL
Q622	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q623	31-20-1701	FET	TOSHIBA 2SK 170-V
Q624	30-31-8431	TR SI NPN	NEC 2SC1843-E
Q625	30-11-0151	TR SI PNP	TOSHIBA 2SA1015-Y
Q626	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q627	30-30-9451	TR SI NPN	NEC 2SC945-Q
Q628	30-11-0051	TR SI PNP	NEC 2SA1005-L
Q629	30-11-0051	TR SI PNP	NEC 2SA1005-L
Q630	30-30-9451	TR SI NPN	NEC 2SC945-Q
Q631	30-31-8431	TR SI NPN	NEC 2SC1843-E
Q632	30-30-9451	TR SI NPN	NEC 2SC945-Q
Q633	30-30-9451	TR SI NPN	NEC 2SC945-Q
Q701	30-11-0151	TR SI PNP	TOSHIBA 2SA1015-Y
Q702	30-11-0151	TR SI PNP	TOSHIBA 2SA1015-Y
Q703	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q704	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q705	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q706	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q707	30-10-8441	TR SI PNP	HITACHI 2SA844-D
Q708	30-31-9071	TR SI NPN	HITACHI 2SC1907
Q709	30-20-6481	TR SI PNP	HITACHI 2SB648A

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION	
Q710	30-40-6681	TR SI NPN	HITACHI 2SD668A-C
Q711	30-40-6681	TR SI NPN	HITACHI 2SD668A-C
Q712	30-20-6481	TR SI PNP	HITACHI 2SB648A
QCR501	30-31-9071	TR SI NPN	HITACHI 2SC1907
U510	30-90-0141	TRANSISTOR ARRAYS 5 NPN	RCA CA3086
U511	34-00-0215	J-FET INPUT OPEAMP	N.S LF13741N
U512	35-70-0003	QUAD 2-INPUT POSI-NAND	FAIRCHILD 74F00PC
U513	35-70-0001	QUAD 2-INPUT POSI-NAND	T.I SN74LS00N
U601	35-70-0001	QUAD 2-INPUT POSI-NAND	T.I SN74LS00N
U602	35-70-1122	DUAL J-K F-F	T.I SN74S112N
U603	35-70-1122	DUAL J-K F-F	T.I SN74S112N
U604	34-00-0215	J-FET INPUT OPEAMP	N.S LF13741N
U605	34-00-0215	J-FET INPUT OPEAMP	N.S LF13741N
U606	35-70-1121	DUAL J-K F-F	T.I SN74LS112N
U607	34-69-0030	TRIPLE 2-CHANNEL MULTIPLEXER	TOSHIBA TC4053BP
R510	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R511	40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R512	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
R513	40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W	
R514	40-27-2822	FXD C FILM 8.2K OHM 5% 1/4W	
R515	40-27-2272	FXD C FILM 2.7K OHM 5% 1/4W	
R516	42-73-4900	FXD M FILM 900K OHM 0.5% 1/2W	
R517	42-71-4111	FXD M FILM 111K OHM 0.5% 1/4W	
R519	40-27-3472	FXD C FILM 47K OHM 5% 1/4W	
R520	40-27-4472	FXD C FILM 470K OHM 5% 1/4W	
R521	42-73-5100	FXD M FILM 1M OHM 0.5% 1/2W 100PPM/DEG	
R522	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R523	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R524	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R525	40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R526	40-27-2122	FXD C FILM 1.2K OHM 5% 1/4W	
R527	40-27-2122	FXD C FILM 1.2K OHM 5% 1/4W	
R528	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R529	40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W	
R530	40-27-1562	FXD C FILM 560 OHM 5% 1/4W	
R532	40-27-1472	FXD C FILM 470 OHM 5% 1/4W	
R533	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
R534	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
R535	40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R536	40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R537	40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R538	40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R539	40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W	
R540	40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W	
R541	40-27-1332	FXD C FILM 330 OHM 5% 1/4W	
R542	40-27-1332	FXD C FILM 330 OHM 5% 1/4W	
R543	40-27-5102	FXD C FILM 1M OHM 5% 1/4W	
R544	40-27-5102	FXD C FILM 1M OHM 5% 1/4W	
R545	40-27-5102	FXD C FILM 1M OHM 5% 1/4W	
R546	40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R547	40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R548	42-72-1220	FXD M FILM 220 OHM 1% 1/4W	
R549	42-72-1560	FXD M FILM 560 OHM 1% 1/4W	
R550	42-72-1560	FXD M FILM 560 OHM 1% 1/4W	
R551	42-72-1220	FXD M FILM 220 OHM 1% 1/4W	
R552	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R553	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R554	40-27-4472	FXD C FILM 470K OHM 5% 1/4W	
R555	40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W	
R556	40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R557	40-27-4472	FXD C FILM 470K OHM 5% 1/4W	
R558	40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R559	40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R560	40-27-1332	FXD C FILM 330 OHM 5% 1/4W	
R561	40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R562	40-27-1472	FXD C FILM 470 OHM 5% 1/4W	
R563	40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R565	40-27-1222	FXD C FILM 220 OHM 5% 1/4W	
R567	40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R568	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
R569	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R570	40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R571	40-27-1332	FXD C FILM 330 OHM 5% 1/4W	
R572	40-27-1102	FXD C FILM 100 OHM 5% 1/4W	

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION
R573	40-27-2122	FXD C FILM 1.2K OHM 5% 1/4W
R574	40-27-1682	FXD C FILM 680 OHM 5% 1/4W
R575	40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R576	40-27-1392	FXD C FILM 390 OHM 5% 1/4W
R577	40-27-2272	FXD C FILM 2.7K OHM 5% 1/4W
R578	40-27-2272	FXD C FILM 2.7K OHM 5% 1/4W
R579	40-27-1682	FXD C FILM 680 OHM 5% 1/4W
R580	40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W
R581	40-27-2682	FXD C FILM 6.8K OHM 5% 1/4W
R582	40-27-2332	FXD C FILM 3.3K OHM 5% 1/4W
R583	40-27-3222	FXD C FILM 22K OHM 5% 1/4W
R584	40-27-1152	FXD C FILM 150 OHM 5% 1/4W
R585	40-27-5102	FXD C FILM 1M OHM 5% 1/4W
R588	40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R594	40-27-0102	FXD C FILM 10 OHM 5% 1/4W
R595	40-27-0222	FXD C FILM 22 OHM 5% 1/4W
R596	40-27-2272	FXD C FILM 2.7K OHM 5% 1/4W
R597	40-27-3102	FXD C FILM 10K OHM 5% 1/4W
R598	40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R599	40-27-1562	FXD C FILM 560 OHM 5% 1/4W
R601	40-27-3102	FXD C FILM 10K OHM 5% 1/4W
R602	40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R605	40-27-1332	FXD C FILM 330 OHM 5% 1/4W
R606	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W
R608	40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R609	40-27-1822	FXD C FILM 820 OHM 5% 1/4W
R610	40-27-3102	FXD C FILM 10K OHM 5% 1/4W
R611	40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W
R612	40-27-0472	FXD C FILM 47 OHM 5% 1/4W
R613	40-27-0472	FXD C FILM 47 OHM 5% 1/4W
R614	40-27-1332	FXD C FILM 330 OHM 5% 1/4W
R615	40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R616	40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R617	40-27-3222	FXD C FILM 22K OHM 5% 1/4W
R618	40-27-1562	FXD C FILM 560 OHM 5% 1/4W
R619	40-27-3102	FXD C FILM 10K OHM 5% 1/4W
R620	42-72-3200	FXD M FILM 20K OHM 1% 1/4W
R621	42-72-3330	FXD M FILM 33K OHM 1% 1/4W
R622	40-27-2822	FXD C FILM 8.2K OHM 5% 1/4W
R623	40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R624	40-27-1562	FXD C FILM 560 OHM 5% 1/4W
R625	40-27-1222	FXD C FILM 220 OHM 5% 1/4W
R626	40-27-1562	FXD C FILM 560 OHM 5% 1/4W
R627	40-27-1472	FXD C FILM 470 OHM 5% 1/4W
R628	40-27-3562	FXD C FILM 56K OHM 5% 1/4W
R629	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W
R630	40-27-2332	FXD C FILM 3.3K OHM 5% 1/4W
R631	40-27-3332	FXD C FILM 33K OHM 5% 1/4W
R632	40-27-2332	FXD C FILM 3.3K OHM 5% 1/4W
R633	40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R634	40-27-2472	FXD C FILM 4.7K OHM 5% 1/4W
R635	40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W
R636	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W
R638	40-27-3102	FXD C FILM 10K OHM 5% 1/4W
R639	42-72-3200	FXD M FILM 20K OHM 1% 1/4W
R640	42-72-3330	FXD M FILM 33K OHM 1% 1/4W
R641	40-27-1102	FXD C FILM 100 OHM 5% 1/4W
R642	40-27-2102	FXD C FILM 1K OHM 5% 1/4W
R643	40-27-0472	FXD C FILM 47 OHM 5% 1/4W
R644	40-27-0472	FXD C FILM 47 OHM 5% 1/4W
R645	40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W
R646	40-27-1332	FXD C FILM 330 OHM 5% 1/4W
R647	40-27-1332	FXD C FILM 330 OHM 5% 1/4W
R648	40-27-3222	FXD C FILM 22K OHM 5% 1/4W
R650	40-27-3182	FXD C FILM 18K OHM 5% 1/4W
R651	40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W
R652	40-27-1122	FXD C FILM 120 OHM 5% 1/4W
R653	40-27-4472	FXD C FILM 470K OHM 5% 1/4W
R654	40-27-3102	FXD C FILM 10K OHM 5% 1/4W
R655	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W
R656	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W
R657	40-27-3102	FXD C FILM 10K OHM 5% 1/4W
R658	40-27-3182	FXD C FILM 18K OHM 5% 1/4W
R659	40-27-2472	FXD C FILM 4.7K OHM 5% 1/4W
R660	40-27-3182	FXD C FILM 18K OHM 5% 1/4W
R661	40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W
R662	40-27-1122	FXD C FILM 120 OHM 5% 1/4W

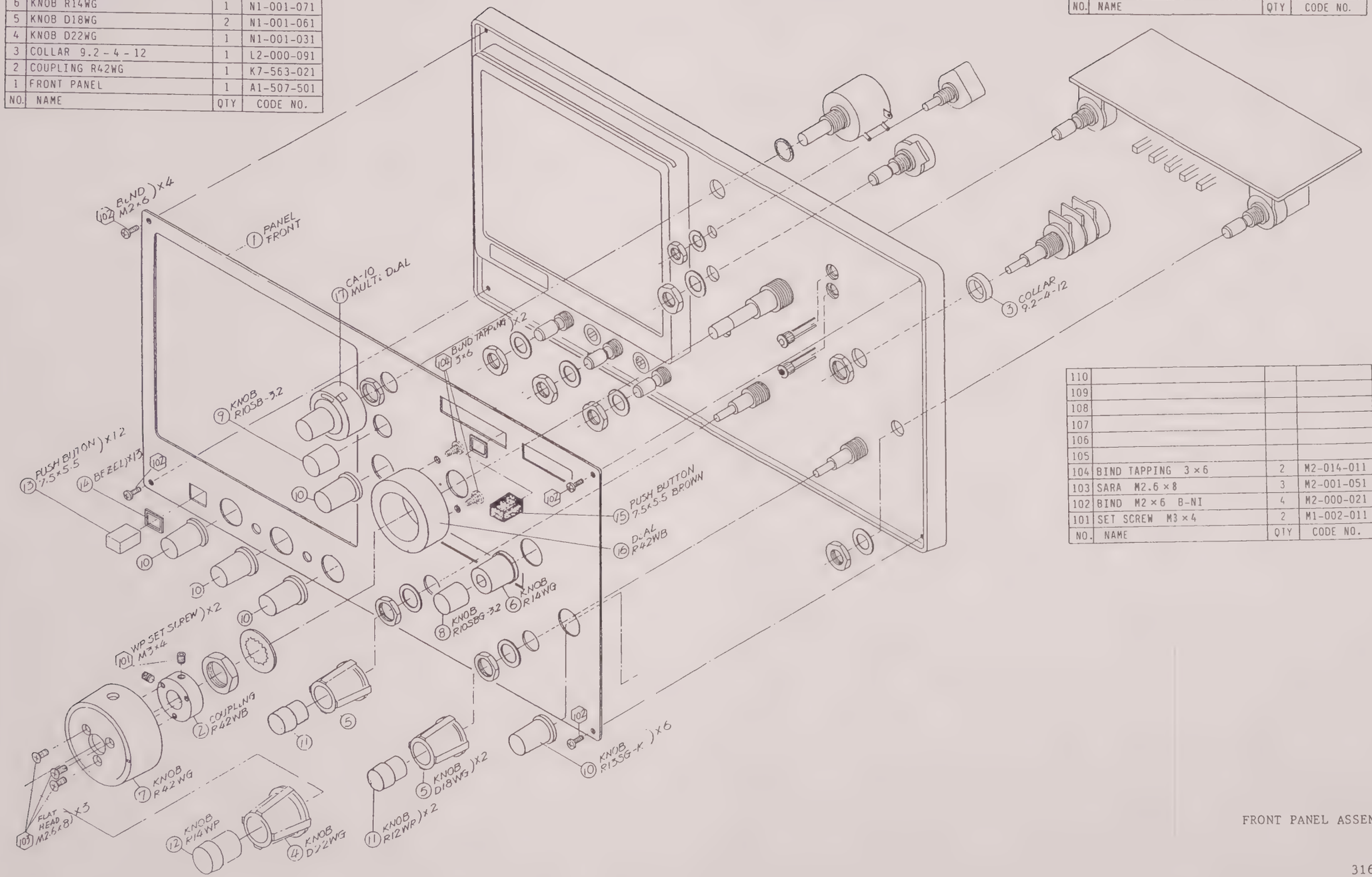
REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION	
R663	40-27-4472	FXD C FILM 470K OHM 5% 1/4W	
R664	40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R665	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
R666	40-27-2182	FXD C FILM 1.8K OHM 5% 1/4W	
R667	40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R668	40-27-3182	FXD C FILM 18K OHM 5% 1/4W	
R669	40-27-3152	FXD C FILM 15K OHM 5% 1/4W	
R670	40-27-1102	FXD C FILM 100 OHM 5% 1/4W	
R671	44-25-0000	FXD M GLAZE R-NETWORK	KIKUSUI S8109021
R672	44-25-0000	FXD M GLAZE R-NETWORK	KIKUSUI S8109021
R673	40-27-2332	FXD C FILM 3.3K OHM 5% 1/4W	
R675	40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R678	40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R680	40-27-0222	FXD C FILM 22 OHM 5% 1/4W	
R681	40-27-1222	FXD C FILM 220 OHM 5% 1/4W	
R682	40-27-3102	FXD C FILM 10K OHM 5% 1/4W	
R683	40-27-3222	FXD C FILM 22K OHM 5% 1/4W	
R684	40-27-1472	FXD C FILM 470 OHM 5% 1/4W	
R685	40-27-3222	FXD C FILM 22K OHM 5% 1/4W	
R686	40-27-0332	FXD C FILM 33 OHM 5% 1/4W	
R687	40-27-0332	FXD C FILM 33 OHM 5% 1/4W	
R691	40-27-0222	FXD C FILM 22 OHM 5% 1/4W	
R694	40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R695	40-27-0102	FXD C FILM 10 OHM 5% 1/4W	
R696	40-27-1562	FXD C FILM 560 OHM 5% 1/4W	
R701	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R702	40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W	
R703	40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W	
R704	40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W	
R705	40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W	
R706	40-27-2152	FXD C FILM 1.5K OHM 5% 1/4W	
R707	40-27-2682	FXD C FILM 6.8K OHM 5% 1/4W	
R708	40-27-1472	FXD C FILM 470 OHM 5% 1/4W	
R709	40-27-2392	FXD C FILM 3.9K OHM 5% 1/4W	
R710	40-27-1472	FXD C FILM 470 OHM 5% 1/4W	
R711	40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R712	40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R713	40-27-2102	FXD C FILM 1K OHM 5% 1/4W	
R714	40-27-1332	FXD C FILM 330 OHM 5% 1/4W	
R715	40-27-3122	FXD C FILM 12K OHM 5% 1/4W	
R716	40-27-1332	FXD C FILM 330 OHM 5% 1/4W	
R717	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
R718	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
R719	40-27-4102	FXD C FILM 100K OHM 5% 1/4W	
R720	42-74-4100	FXD M FILM 100K OHM 1% 1/2W	
R721	42-74-4100	FXD M FILM 100K OHM 1% 1/2W	
R722	40-27-4102	FXD C FILM 100K OHM 5% 1/4W	
R723	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
R724	40-27-2222	FXD C FILM 2.2K OHM 5% 1/4W	
R725	40-27-1562	FXD C FILM 560 OHM 5% 1/4W	
R726	40-27-1562	FXD C FILM 560 OHM 5% 1/4W	
R727	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R728	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R729	40-27-2562	FXD C FILM 5.6K OHM 5% 1/4W	
R730	40-27-3392	FXD C FILM 39K OHM 5% 1/4W	
R731	40-27-4102	FXD C FILM 100K OHM 5% 1/4W	
RV502	48-33-1500	VAR M FILM 500 OHM	
RV503	48-33-1100	VAR M FILM 100 OHM	
RV504	48-33-1500	VAR M FILM 500 OHM	
RV601	48-33-3100	VAR M FILM 10K OHM	
RV603	48-33-2500	VAR M FILM 5K OHM	
RV604	48-33-1100	VAR M FILM 100 OHM	
RV606	48-33-3100	VAR M FILM 10K OHM	
RV608	48-33-2100	VAR M FILM 1K OHM	
RV701	48-33-1100	VAR M FILM 100 OHM	
C510	54-00-0311	FXD ELECT 10UF 50V	
C511	50-67-0010	FXD PLSTC FILM 0.0022UF 10% 100V	
C512	57-10-1180	VAR CER 1.5-4PF	
C513	57-10-1190	VAR CER 3-10PF	
C514	52-06-3145	FXD CER 22PF 10% 500V TYPE1	
C515	50-67-0040	FXD PLSTC FILM 0.022UF 10% 100V	
C516	52-06-3185	FXD CER 47PF 10% 500V TYPE1	
C517	54-00-0311	FXD ELECT 10UF 50V	
C518	54-00-0311	FXD ELECT 10UF 50V	
C519	57-10-1191	VAR CER 3-10PF	

REFERENCE DESIGNATOR		KIKUSUI PARTS NO.	DESCRIPTION
C520		52-06-3145	FXD CER 22PF 10% 500V TYPE1
C521		55-37-2050	FXD TANT ELECT 1UF 35V
C522		55-37-2050	FXD TANT ELECT 1UF 35V
C523		55-37-2050	FXD TANT ELECT 1UF 35V
C524		54-00-0311	FXD ELECT 10UF 50V
C525		50-67-0030	FXD PLSTC FILM 0.01UF 10% 100V
C526		54-00-0311	FXD ELECT 10UF 50V
C527		52-06-2225	FXD CER 100PF 10% 50V TYPE1
C528		54-00-0114	FXD ELECT 47UF 25V
C529		54-00-0311	FXD ELECT 10UF 50V
C530		52-06-3030	FXD CER 3PF 10% 500V TYPE1
C531		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C532		52-01-3345	FXD CER 1000PF 10% 500V TYPE2
C533		50-67-0040	FXD PLSTC FILM 0.022UF 10% 100V
C534		54-00-0311	FXD ELECT 10UF 50V
C535		54-00-0311	FXD ELECT 10UF 50V
C536		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C537		52-06-2225	FXD CER 100PF 10% 50V TYPE1
C538		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C539		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C540		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C544		54-00-0114	FXD ELECT 47UF 25V
C545		52-06-3051	FXD CER 5PF 10% 500V TYPE1
C546		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C603		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C604		52-05-1498	FXD CER 0.1UF +80-20% 25V TYPE2
C605		50-67-0050	FXD PLSTC FILM 0.047UF 10% 100V
C606		54-00-0114	FXD ELECT 47UF 25V
C607		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C608		52-06-3185	FXD CER 47PF 10% 500V TYPE1
C609		52-06-2215	FXD CER 82PF 10% 500V TYPE1
C610		57-10-1203	VAR CER 5-20PF
C611		50-65-0540	FXD M PLSTC FILM 1UF 5% 100V
C612		52-06-2225	FXD CER 100PF 10% 50V TYPE1
C614		54-00-0311	FXD ELECT 10UF 50V
C615		52-05-1498	FXD CER 0.1UF +80-20% 25V TYPE2
C616		52-06-2215	FXD CER 82PF 10% 500V TYPE1
C617		57-10-1203	VAR CER 5-20PF
C618		50-65-0540	FXD M PLSTC FILM 1UF 5% 100V
C619		52-06-2225	FXD CER 100PF 10% 50V TYPE1
C620		52-06-3185	FXD CER 47PF 10% 500V TYPE1
C621		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C622		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C623		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C624		55-37-2050	FXD TANT ELECT 1UF 35V
C625		52-05-1498	FXD CER 0.1UF +80-20% 25V TYPE2
C626		54-00-0311	FXD ELECT 10UF 50V
C627		54-00-0311	FXD ELECT 10UF 50V
C629		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C630		54-00-0311	FXD ELECT 10UF 50V
C631		54-00-0311	FXD ELECT 10UF 50V
C632		54-00-0311	FXD ELECT 10UF 50V
C633		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C634		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C635		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C636		54-00-0311	FXD ELECT 10UF 50V
C637		52-06-3102	FXD CER 10PF 10% 500V TYPE1
C638		50-67-0030	FXD PLSTC FILM 0.01UF 10% 100V
C639		54-00-0121	FXD ELECT 100UF 25V
C640		52-06-2245	FXD CER 150PF 10% 50V TYPE1
C641		54-00-0311	FXD ELECT 10UF 50V
C642		54-00-0311	FXD ELECT 10UF 50V
C643		54-00-0311	FXD ELECT 10UF 50V
C644		54-00-0311	FXD ELECT 10UF 50V
C645		54-00-0311	FXD ELECT 10UF 50V
C646		52-06-3051	FXD CER 5PF 10% 500V TYPE1
C647		52-06-3051	FXD CER 5PF 10% 500V TYPE1
C648		52-05-2468	FXD CER 0.01UF +80-20% 50V TYPE2
C649		52-06-2265	FXD CER 220PF 10% 50V TYPE1
C650		54-00-0311	FXD ELECT 10UF 50V
C651		54-00-0311	FXD ELECT 10UF 50V
C701		52-01-2285	FXD CER 330PF 10% 50V TYPE2
C702	*	52-01-3345	FXD CER 1000PF 10% 500V TYPE2
C703		52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2
C704		52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2
C705		52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2
C706		52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION	
C707	54-00-0311	FXD ELECT 10UF 50V	
C708	52-03-3469	FXD CER 0.01UF +100-0% 500V TYPE2	
C709	54-00-0311	FXD ELECT 10UF 50V	
C710	54-00-0311	FXD ELECT 10UF 50V	
L510	67-10-0940	INDUCTOR 10UH 10%	
L601	67-10-0880	INDUCTOR 2.2UH 20%	
L602	67-10-0880	INDUCTOR 2.2UH 20%	
S502	82-70-5242	LEVER SWITCH	ALPS SLR524-2
S503	82-70-5242	LEVER SWITCH	ALPS SLR524-2
S504	82-70-5222	PUSH SWITCH	ALPS SLR522-2
S604	80-99-0080	SW ROTARY WITH RV SWEEP/DIV	ALPS S32C2YF
A7 ASSEMBLY			
CR824	32-90-1951	DIODE VR=6KV FAST RECOVERY	SANKEN GHV-06SSN
CR825	32-90-1951	DIODE VR=6KV FAST RECOVERY	SANKEN GHV-06SSN
CR826	32-90-1951	DIODE VR=6KV FAST RECOVERY	SANKEN GHV-06SSN
CR827	32-90-1951	DIODE VR=6KV FAST RECOVERY	SANKEN GHV-06SSN
CR828	32-90-1951	DIODE VR=6KV FAST RECOVERY	SANKEN GHV-06SSN
CR829	32-90-1951	DIODE VR=6KV FAST RECOVERY	SANKEN GHV-06SSN
CR830	32-90-1951	DIODE VR=6KV FAST RECOVERY	SANKEN GHV-06SSN
R860	40-37-6101	FXD C FILM 10M OHM 5% 1/2W	
R861	40-37-3221	FXD C FILM 22K OHM 5% 1/2W	
C834	52-98-1010	FXD CER 1000PF +80-20% 6.3KV TYPE1	
C835	52-98-1010	FXD CER 1000PF +80-20% 6.3KV TYPE1	
C836	52-98-1010	FXD CER 1000PF +80-20% 6.3KV TYPE1	
C837	52-98-1010	FXD CER 1000PF +80-20% 6.3KV TYPE1	
C838	52-98-1010	FXD CER 1000PF +80-20% 6.3KV TYPE1	
C839	52-98-1010	FXD CER 1000PF +80-20% 6.3KV TYPE1	
C840	52-98-1000	FXD CER 4700PF +80-20% 3.15KV TYPE1	
C841	52-98-1000	FXD CER 4700PF +80-20% 3.15KV TYPE1	
C862	52-98-1000	FXD CER 4700PF +80-20% 3.15KV TYPE1	
B ASSEMBLY			
CR521	37-00-0092	LAMP LED RED	TOSHIBA TLG102KW
CR523	37-00-0082	LAMP LED RED	TOSHIBA TLR102KW
CR630	37-00-0082	LAMP LED RED	TOSHIBA TLR102KW
R101	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R201	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R518	40-27-0472	FXD C FILM 47 OHM 5% 1/4W	
R589	40-27-2682	FXD C FILM 6.8K OHM 5% 1/4W	
R590	40-27-2682	FXD C FILM 6.8K OHM 5% 1/4W	
R604	40-27-2682	FXD C FILM 6.8K OHM 5% 1/4W	
R674	44-07-0020	FXD M GLAZE RESISTOR NETWORKS 10K OHM X4	
RV109	45-35-3104	VAR C COMP 10K OHM	
RV209	45-01-0680	VAR C COMP 10K OHM WITH SWITCH	
RV301	45-35-3103	VAR C COMP 10K OHM	
RV501	45-01-0550	VAR C COMP 10K/100K OHM B	
RV605	49-26-3100	POTENTIOMETOR 10K OHM	
RV610	45-35-3103	VAR C COMP 10K OHM	
RV611	46-20-3101	VAR M GLAZE 10K OHM B	
C117	52-06-2215	FXD CER 82PF 10% 500V TYPE1	
C217	52-06-2215	FXD CER 82PF 10% 500V TYPE1	
C601	52-01-3345	FXD CER 1000PF 10% 500V TYPE2	
C801	52-77-1000	FXD CER 100PF 250VAC	
C802	52-77-1000	FXD CER 100PF 250VAC	
S501	81-05-0220	PUSH SWITCH	ALPS SUE50
S601	81-03-0270	PUSH SWITCH	ALPS SUE30
S602	81-04-0260	PUSH SWITCH	ALPS SUE40
S1601	81-01-0270	PUSH SWITCH	ALPS SDG5P-E
T801	60-44-0110	POWER TRANS	KIKUSUI S820041
V801	21-46-0604	CRT	MATSUSHITA 150BYB31
L801	66-21-0060	ROTATION COIL	KIKUSUI S7901141
DL401	91-90-0003	DELEY LINE 1.3M Z=180 OHM	

NO.	NAME	QTY	CODE NO.
14	BEZEL FOR PUSH BUTTON	13	P2-000-331
13	PUSH BUTTON 7.5×5.5	12	P2-000-321
12	KNOB R14WR	1	N2-000-061
11	KNOB R12WR - 2.5	2	N2-000-051
10	KNOB R13SG - K	6	N1-001-121
9	KNOB R10SB - 3.2	1	N1-001-111
8	KNOB R10SBG - 3.2	1	N1-001-101
7	KNOB R42WG	1	N1-001-091
6	KNOB R14WG	1	N1-001-071
5	KNOB D18WG	2	N1-001-061
4	KNOB D22WG	1	N1-001-031
3	COLLAR 9.2 - 4 - 12	1	L2-000-091
2	COUPLING R42WG	1	K7-563-021
1	FRONT PANEL	1	A1-507-501

NO.	NAME	QTY	CODE NO.
22			
21			
20			
19			
18			
17	CA-10 MULTI DIAL	1	W1-000-012
16	DIAL R42WB	1	S2-507-501
15	PUSH BUTTON 7.5×5.5 BR	1	P2-000-371



NO.	NAME	QTY	CODE NO.
110			
109			
108			
107			
106			
105			
104	BIND TAPPING 3×6	2	M2-014-011
103	SARA M2.6×8	3	M2-001-051
102	BIND M2×6 B-NI	4	M2-000-021
101	SET SCREW M3×4	2	M1-002-011

FRONT PANEL ASSEMBLY

316096

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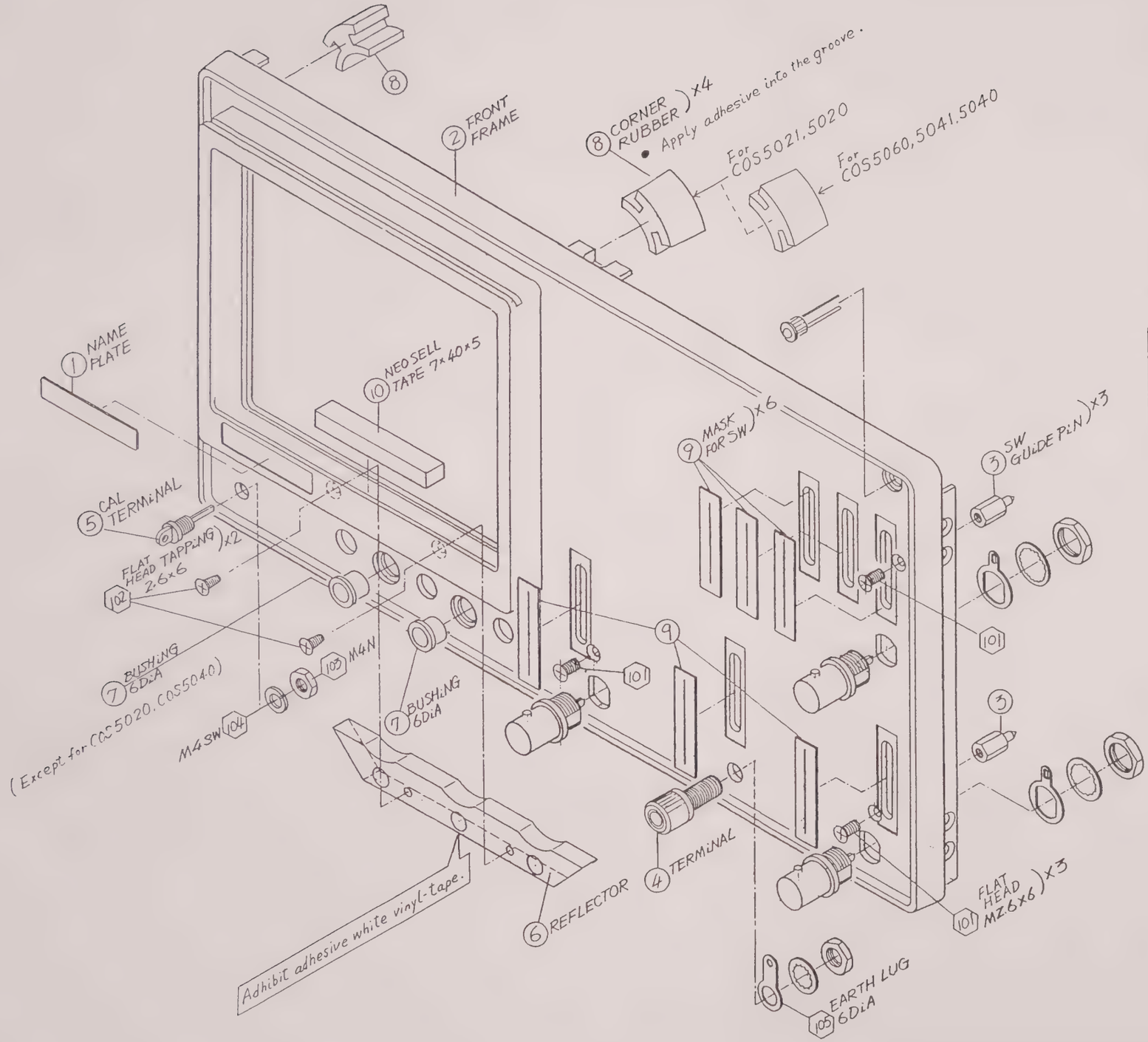
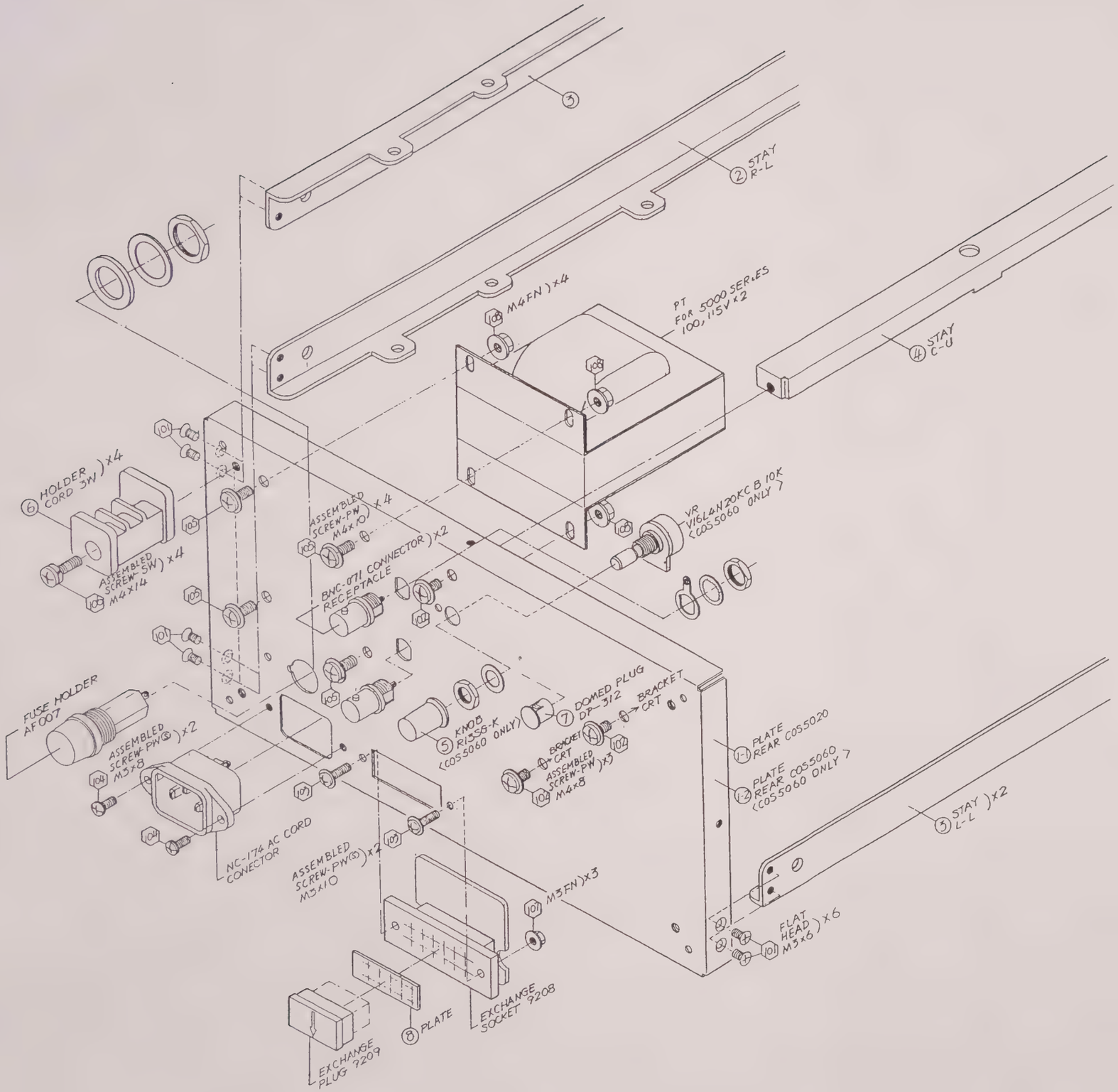


NO.	NAME	QTY	CODE NO.
15			
14			
13			
12			
11			
10	RUBBER TAPE 7×40×5	1	R3-050-041
9	MASK FOR SW	6	Q9-507-101
8	CORNER RUBBER FOR CRT	4	P5-507-101
7	SNAP BUSHING 6DIA	1+(1)	P4-000-771
6	REFLECTOR	1	P3-507-101
5	CAL TERMINAL	1	P2-000-291
4	TERMINAL GND SHORT	1	L4-000-021
3	SW GUIDE PIN	3	L3-506-702
2	FRONT FRAME	1	B9-050-151
1	NAME PLATE KIKUSUI	1	A8-000-621

NO.	NAME	QTY	CODE NO.
105	EARTH LUG 6DIA	1	M6-000-151
104	SPRING WASHER M4SW	1	M5-011-041
103	NUT M4N	1	M4-011-041
102	FLAT HEAD SCREW TAPPING 2.6×6	2	M2-001-401
101	FLAT HEAD SCREW M2.6×6	3	M2-001-041

FRONT FRAME ASSEMBLY
(COMMON DRAWING)

316099



110			
109	ASSEMBLED SCREW-PW M3×6 B-NI	1	M3-000-011
108	FLANGE NUT M4FN	4	M4-010-031
107	FLANGE NUT M3FN	3	M4-010-021
106	ASSEMBLED SCREW-SW M4×14	4	M3-011-101
105	ASSEMBLED SCREW-PW M4×10 B-NI	4	M3-000-061
104	ASSEMBLED SCREW-PW(S) M3×8 B-NI	2	M3-000-041
103	ASSEMBLED SCREW-PW(S) M3×10 B-NI	2	M3-000-051
102	ASSEMBLED SCREW-PW M4×8 B-NI	3	M3-000-021
101	FLAT HEAD SCREW M3×6	6	M2-001-081
NO.	NAME	QTY	CODE NO.

COS5020,5021,5040,5041

7	DOMED PLUG DP-312	1	P4-050-081
1-1	REAR PLATE COS5020	1	B6-507-101
NO.	NAME	QTY	CODE NO.

FOR COS5060 ONLY

5	ROUND KNOB R13SG-K	1	N1-001-121
1-2	REAR PLATE COS5060	1	B6-507-501
NO.	NAME	QTY	CODE NO.

8	PLATE VOLTAGE SELECTOR	1	Q2-000-191
6	HOLDER CORD 3W	4	P3-000-101
4	STAY C-U	1	D5-507-103
3	STAY L-L	2	D5-507-102
2	STAY R-L	1	D5-507-101
NO.	NAME	QTY	CODE NO.

REAR PLATE ASSEMBLY

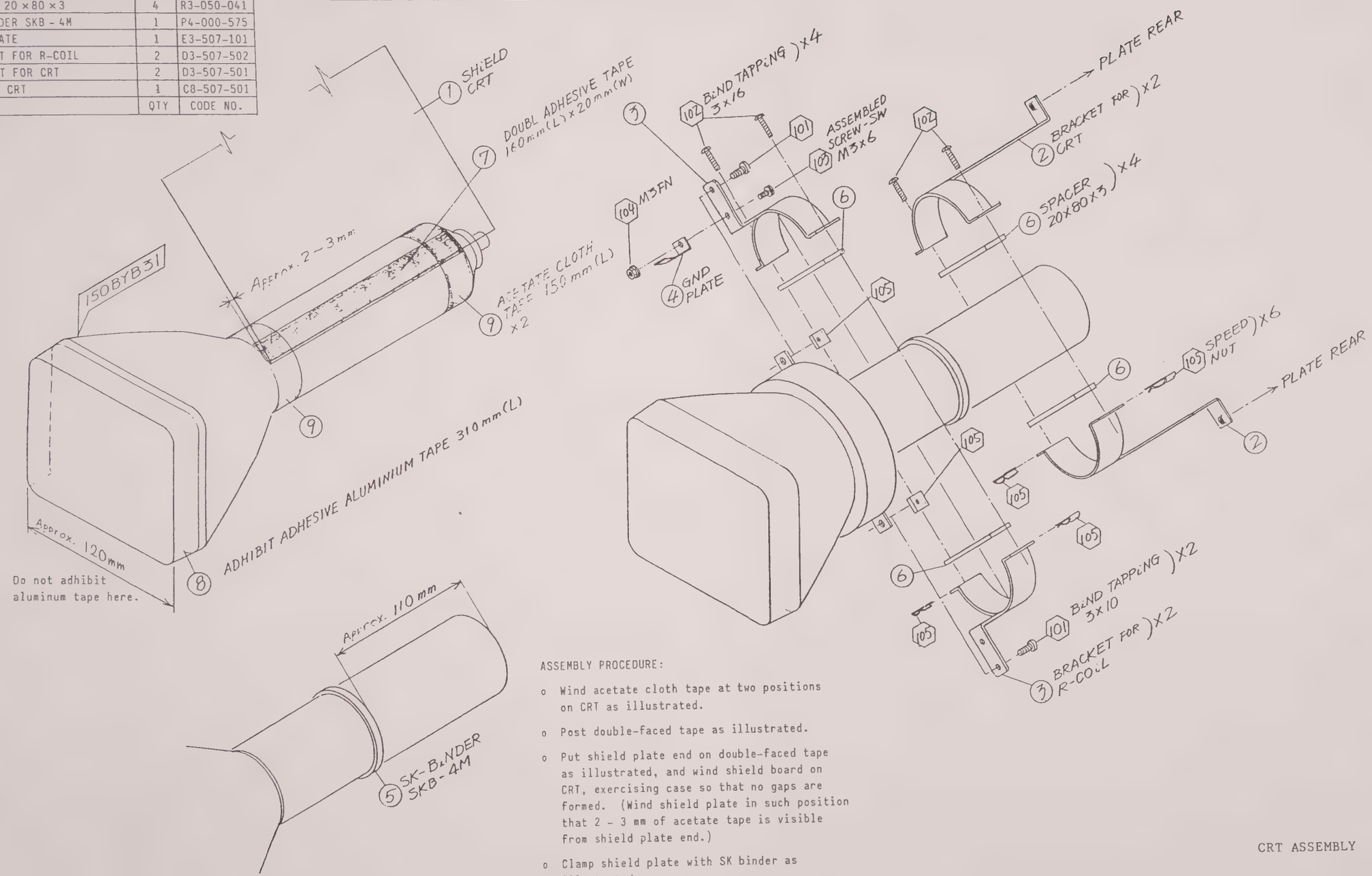
(COMMON DRAWING)

316100

16/19

12			
11			
10			
9	ADHESIVE TAPE'ACETATE'571S	300mm	T4-000-131
8	ADHESIVE TAPE'ALUMI'833S	310mm	T4-000-121
7	ADHESIVE TAPE NO.721B W=20	161mm	T4-000-091
6	SPACER 20×80×3	4	R3-050-041
5	SK-BINDER SKB-4M	1	P4-000-575
4	GND PLATE	1	E3-507-101
3	BRACKET FOR R-COIL	2	D3-507-502
2	BRACKET FOR CRT	2	D3-507-501
1	SHIELD CRT	1	C8-507-501
NO.	NAME	QTY	CODE NO.

105	U-TYPE SPEED NUT	6	M8-000-391
104	FLANGE NUT M3FN	1	M4-010-021
103	SEMS-SW M3×6	1	M3-011-011
102	BIND TAPPING 3×16	4	M2-014-051
101	BIND TAPPING 3×10	2	M2-014-031
NO.	NAME	QTY	CODE NO.



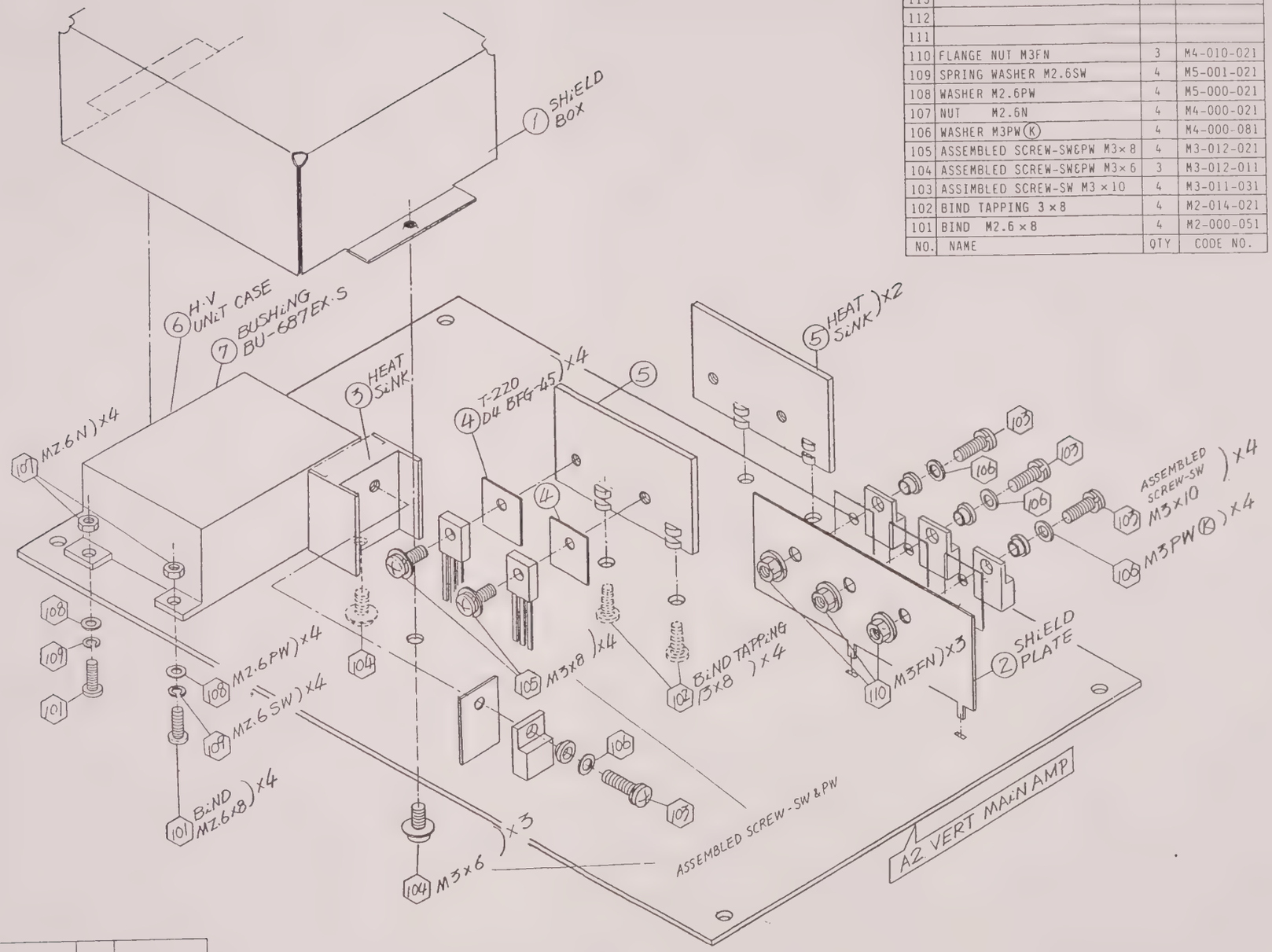
ASSEMBLY PROCEDURE:

- Wind acetate cloth tape at two positions on CRT as illustrated.
- Post double-faced tape as illustrated.
- Put shield plate end on double-faced tape as illustrated, and wind shield board on CRT, exercising case so that no gaps are formed. (Wind shield plate in such position that 2 - 3 mm of acetate tape is visible from shield plate end.)
- Clamp shield plate with SK binder as illustrated.

CRT ASSEMBLY

316101

114			
113			
112			
111			
110	FLANGE NUT M3FN	3	M4-010-021
109	SPRING WASHER M2.6SW	4	M5-001-021
108	WASHER M2.6PW	4	M5-000-021
107	NUT M2.6N	4	M4-000-021
106	WASHER M3PW(K)	4	M4-000-081
105	ASSEMBLED SCREW-SW&PW M3×8	4	M3-012-021
104	ASSEMBLED SCREW-SW&PW M3×6	3	M3-012-011
103	ASSIMBLED SCREW-SW M3×10	4	M3-011-031
102	BIND TAPPING 3×8	4	M2-014-021
101	BIND M2.6×8	4	M2-000-051
NO.	NAME	QTY	CODE NO.



10			
9			
8			
7	BUSHING RUBBER BU687EXS	1	P4-000-781
6	H.V UNIT CASE	1	P1-050-041
5	HEAT SINK	2	H1-505-801
4	TO-220 D4 BFG-45	4	X1-000-241
3	IC-2425-ST HEAT SINK	1	H2-000-181
2	SHIELD PLATE	1	C9-050-131
1	SHIELD BOX	1	C8-505-601 (2)
NO.	NAME	QTY	CODE NO.

CIRCUIT BOARD ASSEMBLY

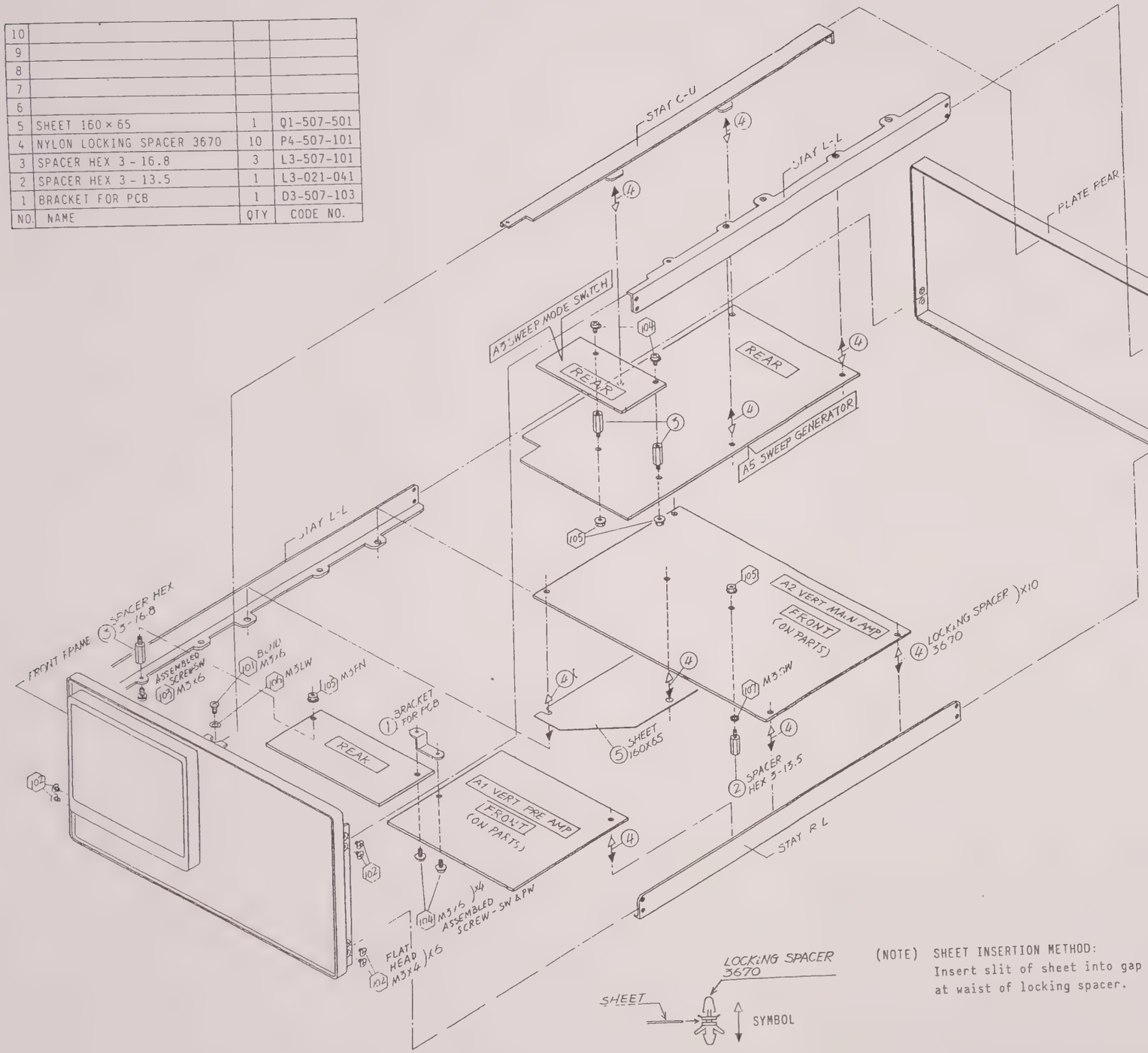
(VERTICAL)

316103

16/21

10			
9			
8			
7			
6			
5	SHEET 160×65	1	Q1-507-501
4	NYLON LOCKING SPACER 3670	10	P4-507-101
3	SPACER HEX 3-16.8	3	L3-507-101
2	SPACER HEX 3-13.5	1	L3-021-041
1	BRACKET FOR PCB	1	D3-507-103
NO.	NAME	QTY	CODE NO.

110			
109			
108			
107	SPRING WASHER M3SW	1	M5-011-031
106	LOCK WASHER M3LW	1	M5-002-051
105	FLANGE NUT M3FN	4	M4-010-021
104	ASSEMBLED SCREW-SW&PW M3×6	4	M3-012-011
103	ASSEMBLED SCREW-SW M3×6	1	M3-011-011
102	FLAT HEAD SCREW M3×4	6	M2-001-071
101	BIND M3×6 B-NI	1	M2-000-391
NO.	NAME	QTY	CODE NO.



(NOTE) SHEET INSERTION METHOD:
Insert slit of sheet into gap at waist of locking spacer.

CIRCUIT BOARDS INSTALLATION

316105

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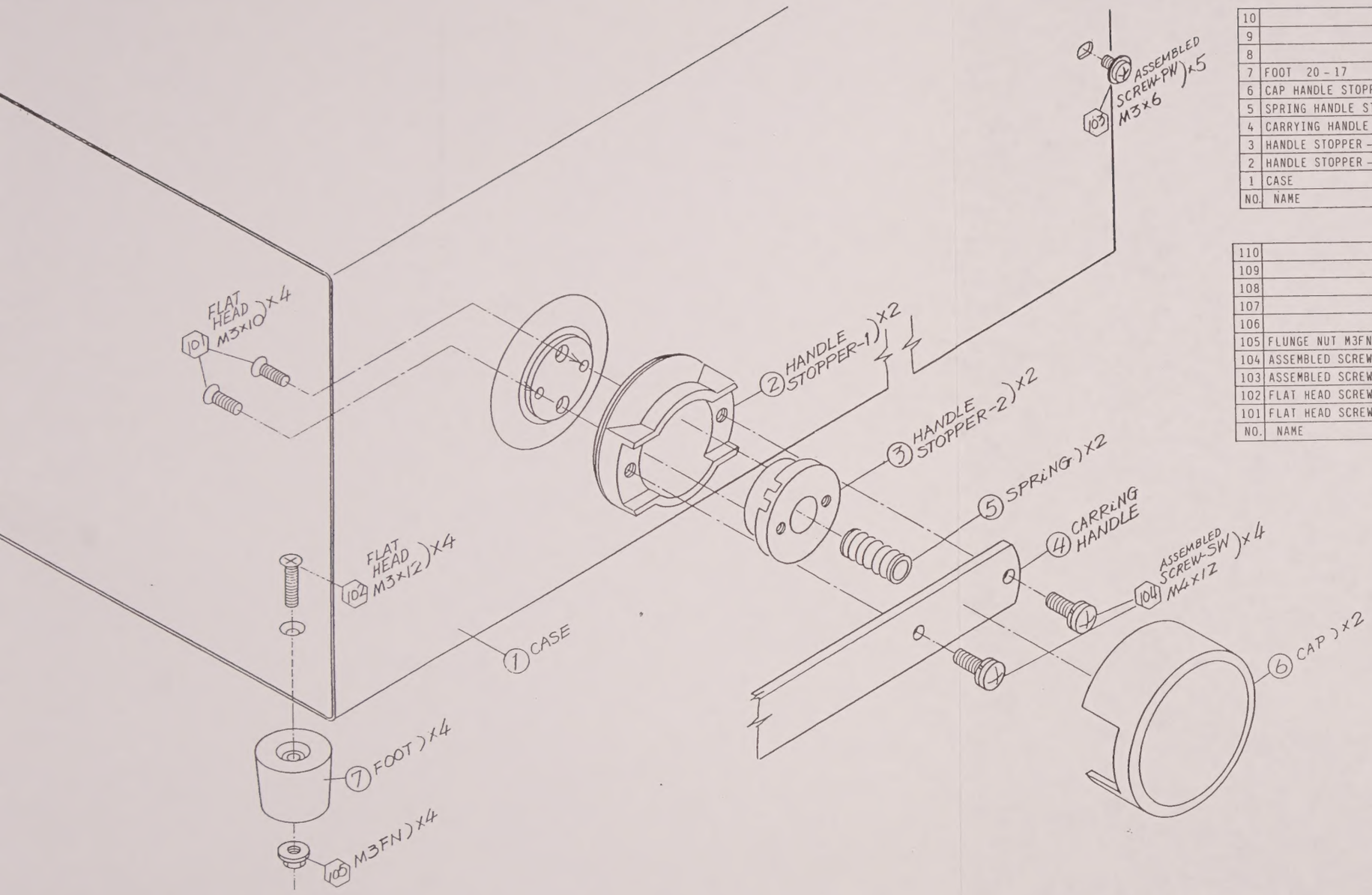

10			
9			
8			
7	FOOT 20 - 17	4	P2-000-381
6	CAP HANDLE STOPPER	2	P1-050-011
5	SPRING HANDLE STOPPER	2	L5-050-011
4	CARRYING HANDLE	1	E6-507-101
3	HANDLE STOPPER - 2	2	E6-050-071
2	HANDLE STOPPER - 1	2	E6-050-061
1	CASE	1	B1-507-501
NO.	NAME	QTY	CODE NO.

110			
109			
108			
107			
106			
105	FLUNGE NUT M3FN	4	M4-010-021
104	ASSEMBLED SCREW-SW M4 x 12	4	M3-011-091
103	ASSEMBLED SCREW-PW M3x6 B-NI	5	M3-000-011
102	FLAT HEAD SCREW M3 x 14	4	M2-011-391
101	FLAT HEAD SCREW M3 x 8	4	M2-001-091
NO.	NAME	QTY	CODE NO.

COVER & HANDLE ASSEMBLY

316108

16/23

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